ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Vol. XXIII. No. 12.

TABLE OF CONTENTS.

Engineering News of the Week.....265, 273, 282

Technical and Illustrated Articles:

Tank Locomotive, Metropolitan District Railway (England)... 267

A New Type of Pneumatic Railway.....267, 268

A Proposed System of Highway Bridge Supervision for the State of New York (*To be continued*)..... 269

The Proposed Lake Superior and Michigan Canal..... 269

Highway Reform in Rhode Island..... 270

Reservoir "M" on Titicus River, New York Water Supply (*with Inset*)..... 271

The Fales Furnace..... 271

Increase in Length of Trains on Austrian Railways 272

The Growth of Duluth's Commerce..... 272

The Castlewood Dam, Denver Water Storage Co 273

Corrections for Baker's "Masonry Construction"..... 274

Notes on the Argentine Republic 281

Personals, Publications Received, Trade Publications, Society Proceedings.....274, 275

Editorial Notes and Editorials 276

Life Insurance in U. S. and Europe—The Colorado Cañon Survey—The Bay View Collision—New England Railroad Club and M. C. B. Couplers.

The Proposed Change in the Engineer Corps of the U. S. Navy 277

The Practice of Water-Works Engineers..... 277

Notes by Rail (*Editorial Correspondence*)..... 278

Correspondence 279-281

The San Diego Sewerage Works—English and American Locomotives—English and American Railway Practice in Mexico—A Simple Method of Sheet Piling—The Proper Location of a Given Frog, when the Turnout Angle is Fixed—Standard Instructions for Engineers—The Water Supply of Plainfield, N. J.—Notes and Queries.

Railways, Rapid Transit, Highways, Water-Works, Bridges, Tunnels and Canals, Electrical, Sewerage and Municipal, Contracting, Proposals Open, Manufacturing and Technical.....283-288

ENGINEERING NEWS.

RAILWAY EARNINGS FOR THE MONTH OF FEBRUARY, according to statistics collected by *Bradstreet's*, show a most favorable increase over the corresponding month of 1889. The total earnings of 135 companies, as reported, aggregated $28,985,530, as against $25,837,195 last year, on a total mileage of 76,733 miles, a gain of 12 per cent. in earnings, and 2.4 per cent. in mileage. The most valuable feature of the table published is the large percentage of increase shown by the Southwestern roads, 21 per cent. Of this group the Atchison, Topeka & Santa Fé shows the largest gain, over 20 per cent., a fact of interest, considering the present financial condition of the company. The Pacific roads show the smallest increase, 6 per cent., and the Granger, Southern, Central Western, and Trunk lines with gains of 15, 13, 10, and 8.5 per cent. respectively.

THE TOTAL GROSS EARNINGS OF 135 RAILWAYS for the first two months of the present year aggregate $60,020,679, a gain of 13 per cent. over the same period of last year. Only 30 of the 135 roads reported show decreases in gross earnings and these generally of small amounts. Taken altogether the situation of the transportation business is remarkably favorable.

A DEPRESSED ROAD ON ATLANTIC AVENUE IN BROOKLYN is the solution of the rapid transit problem in that city. The Rapid Transit Commission has adopted a resolution to that effect and ordered its engineer to prepare plans and specifications for the structure by March 21. The main line is to be a two-track railway from South Ferry to the city line at Queens Co., with a two-track connection with the Manhattan Beach road at East New York, a two-track branch to the freight yard at Carlton Ave. and Pacific St., and single-track sidings at East New York. Leaving out the artistic side of the question, the wisdom of this decision is evident both from the advantage such a structure will have over a four-track elevated road in respect to the value of the abutting property and the cost of maintenance.

CAST STEEL TIRES have been under test for some time on the Austrian State railways. For the trial a locomotive was fitted with three Krupp crucible cast-steel tires on one side and three tires of Martin steel on the other. After two years running, measurements were made showing an average wear on the Krupp tire of 10 m. m. (0.39 in.), while the Martin steel had worn down 14 m. m. (0.55 in.).

THE THOMSON ELECTRIC WELDING PROCESS has been investigated by a board of naval officers appointed by the Secretary of the Navy on Jan. 9. The board finds that the process renders it possible, practically, to weld wrought iron, cast iron, brass and copper rods, from the size of the smallest electrical conductors in use for distributing purposes to rods 2¼ ins. diameter; and to weld pipes of larger sizes; to weld dissimilar metals and pieces of different forms of cross section; to join, by welding, the ends of wire cables, and to form welded rings of small or large diameter. The process itself has been fully described in this journal; but it is interesting to note the uses it can be put to in the navy, ashore and afloat. The board reports:—

"The following may be mentioned as a few of the many applications that would result on shipboard: For welding broken pump piston-rods, valve stems, etc.; for joining wires of iron, copper or other metals or bars of the same, of similar or different shapes or sections; for making joints at angles with bars (T or Y joints); for mending chain and wire rope; for constructing or joining, end to end, pipe of all kinds, and of large or small diameter; working or joining lead pipe; welding T-connections or elbows into lines of piping; welding safe ends to boiler tubes; repairing boiler tubes; welding eye-rings, and welding these again to bolts or bars; repairing cutting and boring tools without hurting their temper; lengthening or shortening rods or bars; repairing broken cast-iron pieces of machinery or broken cast-iron or cast-brass fittings; welding copper electric mains.

"This system of welding thus renders easy many operations in the working of metals which with the forge and smith have heretofore been considered impossible.

"It is the unanimous opinion of the Board that in the present day of ships constructed almost entirely of metal, and in which every fitting possible is made of metal, such a system as that which has been investigated by us becomes not only desirable, but a means to economy of expense, time and labor, and would add to the efficiency of the vessel under any condition of service.

"This system of welding occupies a position of its own; it is able to do not only a large part of the work of the forge now in use, but is capable of doing much work that was hitherto considered impossible. By its use, the large accumulation of now almost worthless boiler tubes stored at the navy yards could be made fit for service: and the quantity of spare tubes and of many other stores now carried by ships could be reduced.

"As the classes of work at naval stations and on shipboard differ materially, the welders designed for use in the two places should be constructed for the work that will be required of them; those for use on board ship being especially designed with a view to lightness, compactness and adaptability to general work."

This report was signed by Commander GEORGE A. CONVERSE, U. S. N., A. S. GREENE, U. S. N., Asst. Naval Constructor S. W. ARMISTEAD, U. S. N., and Ensign GILBERT WILKS, U. S. N.

THE HUNTINGTON ELECTRIC SEARCH LIGHT is being experimented with in San Francisco harbor. The search-light used on war ships is usually a very heavy apparatus, weighing about 1,000 lbs., and costing about $10,000 as made in France. This Huntington light weighs about 130 lbs., is of 4,000 candle-power, and costs $350. One man can easily handle it, and the light is concentrated in parallel rays, instead of being diffused over a wide area as in the war lights. At the distance of half a mile on a dark, clear night buoys could be plainly seen and every rope in the rigging of a ship. It is claimed that the light will penetrate the thickest fog sufficiently to prevent collisions; when turned vertically a column of light ¾ mile high is produced, visible on dark, clear nights many miles away, and visible in the thickest fog at ⅛ mile distant.

A NEW ELECTRIC BRAKE, brought out by two London electricians, consists of two iron disks, one fitted to the inside of the car wheel the other sliding on the axle, but secured so that it cannot revolve. The second disk contains a powerful magnetic coil, which draws it to the other disk when the electric current is turned on, the adhesion causing the wheel to cease its revolution. In trials of this brake on English roads a car running 42 miles an hour is said to have been brought to a standstill in 150 yds., and one traveling 30 miles an hour on a slippery track was stopped in 60 yds.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment, on March 12, of a passenger train on the Canadian Pacific Ry., near Graham's Station, 13 miles from Pembroke, Ont. The accident is said to have been caused by the spreading of the rails. The train consisted of baggage, dining, Pullman and passenger cars; the engine and tender remained on the track, but all the cars went down a 25-foot bank. The wreck caught fire, and the dining car and Pullman car were partly burned, but the flames were extinguished with snow. About 15 persons were injured, some seriously. The train is said to have been running at about 30 miles an hour. ——A large rock rolled down on the track of the Central Ohio division of the Baltimore & Ohio R. R., at Black Head, O., March 14, and threw the Chicago express from the track. The fireman was killed and about seven persons injured, three seriously.——A rear collision occurred March 14 on the Chesapeake & Ohio R. R., near Ronceverte, W. Va. A local freight train ran into the rear of a through freight, which had broken in two and come to a stand-still. The caboose and several cars of the through freight were piled up on each other and took fire. The engine driver, fireman and front brakeman were injured, though not seriously. The accident was, it is said, due to the carelessness of the flagman, who was not far enough from his train to give the local train time to stop.——At Lavalle, Wis., on the Chicago & Northwestern R. R., a collision occurred March 19. A passenger train was being switched onto a side track, when a through passenger train ran into it, wrecking two cars; five or six persons were injured.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: On March 15 one span of the old wooden bridge at Glens Falls, N. Y., gave way while workmen were engaged in preparing for the erection of an iron bridge. The following account is from a local paper sent us by a correspondent: "The stringers and framework for the iron bridge had been laid from the South Glens Falls side of the river to the central pier on the 'island.' On March 14 the workmen began tearing away the west side, or lattice work, of the wooden bridge preparatory to continuing the laying of the stringers for the iron work across the north channel of the stream. The intention was to next take down the lattice work comprising the east side. The floor of the old wooden bridge, a Towne lattice, was to be left in position, and posts had been placed underneath to sustain the weight of iron which it was proposed to put upon it. The men had almost cut away that portion of the lattice work side which fastened it to the floor timbers, and were preparing to push it over into the gulf, when, without a moment's warning, it toppled over. As the lattice work side fell it swung under the bridge, knocking away the temporary trusses. At the same time the force of the impact threw the floor timbers from their foundation. Then the east side fell over and went down with the bottom, carrying the men with it." Two men were killed. The coroner's jury censured the contractors for not using more caution in removing the bridge.——A trestle on the Houston & Texas Central R. R., near Corsicana, Tex., gave way March 9; a train was flagged in time.——A trestle on the Georgia Pacific R. R., near Birmingham, Ala., gave way under a freight train March 13. Twelve cars went down; the stove in the caboose set fire to the wreck, and the cars and trestle were burned. The accident is said to have been caused by a derailed freight car.——A long iron bridge over Pierre Creek, on the Natchez, Jackson & Columbus R. R., between Jackson and Harristown, Miss., was washed away by the flood March 13.——A drawbridge accident occurred March 19 at Newburyport, Mass., on the Boston & Maine R. R. Owing to a snowstorm the engineer of a freight train did not see that the gates on the drawbridge over the Merrimac River were closed, until he was nearly upon the bridge. He could not stop the train owing to the slippery rails and down grade. The draw tenders who were swinging the draw saw the train coming. They succeeded in getting

the draw to within 3 ft. of the closing point, when the train came on and reached the middle of the bridge before stopping. The engine and a car were derailed on the draw. Apparently this draw was not protected by signals or proper safety appliances.

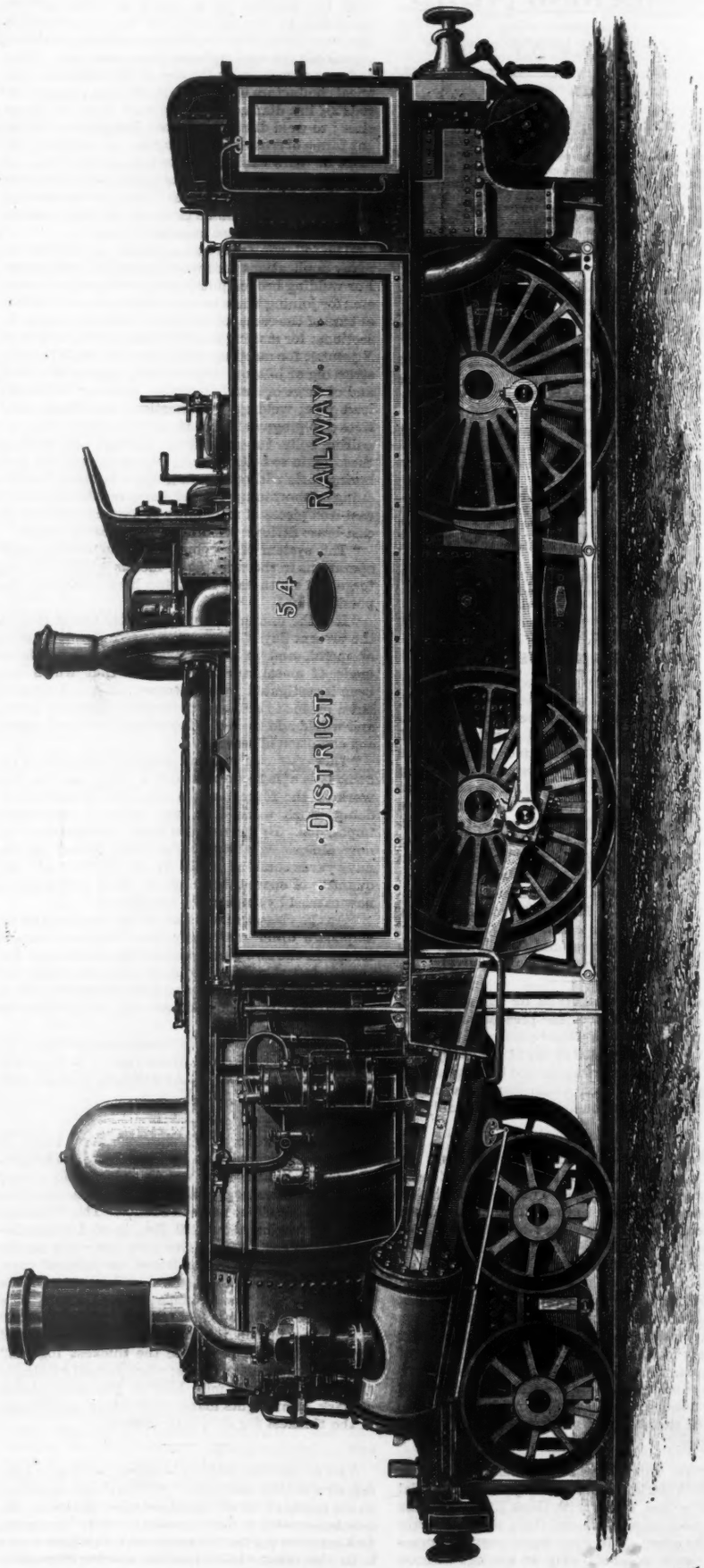
A SERIOUS LANDSLIDE occurred March 15 on the west side of Warren's Hill, Troy, N. Y. It swept away two houses and damaged several others. Two persons were killed and 3 were injured. Further slides are expected. In 1836 a landslide occurred at almost exactly the same place. In 1837, 2 lives were sacrificed by another landslide on Warren Hill, and 16 horses were crushed. In 1841, a third and fourth landslide followed. In 1843 10 buildings were destroyed and 15 persons killed. The last slide previous to the one of March 15 destroyed St. Peter's College, upon which $12,000 had been expended.

THE MISSISSIPPI FLOODS continue and the rupture of levees grows more frequent and alarming. One of the last serious breaks is at Pecan Grove, near Vicksburg, where there is a crevasse over 1,000 ft. wide. The New Orleans *Times-Democrat* says that the water will flood one-fourth of East Carroll parish, a part of Tensas and the greater part of Madison. The crevasse at Convent Point, above New Orleans, is 350 ft. wide and the railroad is carried away for some distance; the flood reaches to College Point, 5 miles below. At New Orleans, where the flood was the highest on record, the river has fallen one inch below the high-water mark of March 15. The new levees in the Greenville district in Mississippi, under the charge of Maj. STARLING, are reported all safe on March 16. So far the Pecan Grove crevasse is the most serious that could have happened. The Louisiana Lottery Co. offered $100,000 to the State for levee protection, but the governor refused the gift. Not to be beaten in this bit of generosity, mixed with self-interest, the president of the Lottery Co. now offers the money to the several parishes threatened and suffering, and it will doubtless be accepted.

THE FLOOD WATERS of the Ohio, Mississippi, and other Western rivers are said to be subsiding slowly. Large tracts of land have been flooded, and much damage has been done to plantations as well as in the cities. In Louisiana much labor and money have been spent in strengthening and repairing the levees, but several breaks have occurred. The Mississippi Levee Commission has allotted $50,000 for levee protection.

THE CHESAPEAKE & OHIO CANAL, under its lease to the Cumberland & Washington R. R. Co., will pay to the State a rental of $15,000 annually. The total price paid for the lease was about $1,400,000, which includes paying off $600,000 of the bonds of 1878, labor claims of $70,000, a judgment of $30,000, and 25 per cent. of the preferred construction bonds of 1844, amounting to about $425,000. The Baltimore & Ohio R. R. was, of course, the bitter opponent of the new company, as it furnished a rival road, with a short route from the coal fields. The projectors of the Cumberland & Washington R. R. are men of large capital and are determined to build a competing line to the Baltimore & Ohio. The fact that the Drum Point or Southern Maryland R. R. has received additional charter privileges, and proposes to extend its line toward Washington, gives color to recent reports that this company will join hands with the Cumberland & Washington Co. The former company has splendid deep-water terminals at Drum Point on Chesapeake Bay, and is six hours nearer the ocean than Baltimore. The Cumberland & Washington Co. could thus have a continuous line from the coal fields to deep water. The West Virginia Central is also reported to be in the scheme. A connection with the Cumberland & Washington would certainly be advantageous to the West Virginia Co.

THE ST. LAWRENCE CANALS, says Sir JNO. MACDONALD, shall be deepened to 14 ft. within the next three years, "to accommodate the largest class of U. S. steamers, and to bring to Canadian waters and ports the greater part of the heavy traffic of grain and produce from the West and coal from the East."



Passenger Tank Engine. Metropolitan District Railway, (England).

Tank Locomotive.—Metropolitan District Railway (England).

The English engine which we illustrate this week, is one of a class used for local service. Like the express engine illustrated in ENGINEERING NEWS, Feb. 22, it is in general similar to the American eight-wheel type, with its outside cylinders, leading truck, equalizing levers, etc. It has, however, the ordinary English plate frames, while the arrangement of the inclined cylinders and the short wheel base of the truck are decidedly non-American. The Metropolitan District Ry. is a city and suburban system, the city portion being one of the underground lines. While running in the tunnel the exhaust is usually turned into the tank, surplus steam escaping through the arched pipe, in front of the weather-board.

The absence of a cab is a very objectionable feature, a relic of the days when it was considered that a man would be more alert and attentive to his duties if subjected to various discomforts, than if sheltered from the weather. It is a strange sight to Americans to see engine drivers and firemen standing at their posts, muffled up in coats and wraps to protect themselves from the rain or snow, against which the weather-board is little or no protection. On many other suburban lines, and on a number of main lines, fairly comfortable cabs are now provided, but in no case, as far as we know, has the American cab been introduced. Most of the English cabs are open at the back or sides, and have no doors for these openings, so that the cab is cold and draughty.

The engines were originally designed by Sir JOHN FOWLER, M. Inst. C. E., and but few alterations and improvements have been introduced, the performance having been very satisfactory. All the engines have been built by Beyer, Peacock & Co., of Manchester. The illustration and particulars are taken from *The Engineer*, May 17, 1889.

The cylinders are 17 × 24 in.; driving wheels, 69 ins. diameter. The tractive force is therefore $\frac{17^2 \times 24}{69}$ = 100 lbs. for each pound of effective pressure per square inch in the cylinder.

The throttle consists of a gun-metal slide working vertically over three ports in the end of the cast-iron steam pipe in the dome. The reversing and expansion gear is worked by a lever on the left hand side of the foot-plate, having a sector with 17 notches. The boiler is fed by two pumps worked by eccentrics on the driving axle. There is one No. 8 Gresham injector, but this is little used when running in consequence of the usual high temperature of the feed-water through the condensation of the exhaust steam. When the engine is running in the tunnels, the exhaust is carried into the tanks through two copper pipes. The tanks have discharge valves under the foot plate, and steam-tight screwed manhole covers. The escape pipes for the tanks are of copper, 6-ins. diameter: they are arched to meet in a 9½ in. mouthpiece over the fire box. The engine is provided with the Westinghouse non-automatic brake, the air-pump being placed against the boiler in front of the tank on the left hand side, and the air reservoir being under the coal bunker.

These engines have a consumption of less than 30 lbs. of coal per mile under heavy work. They undergo general repairs about once in 2¼ years, and are practically in constant work from one general repair to another, one shed day in seven being all the time they are cold. The average total train mileage run by each of the 24 original engines amounted, in May, 1889, to over 485,500 miles. These 24 engines were built in 1871, and had originally Bissel pony trucks instead of the 4-wheel Adams trucks now used. All the engines now have the latter class of trucks. The entire railway has scarcely any straight road; many of the curves are very sharp, and much of the line is provided with check rails. In one case the grade is as steep as 2.22 per cent. (1 in 45), and up this grade nine loaded cars are taken with ease. Mr. GEO. ESTALL is Resident Engineer.

The principal dimensions and particulars of the engines built in 1886 are as follows:

	Ft.	In.
Boiler (Lowmoor plates):		
Length	10	3
Diameter inside at middle	4	0
Thickness of plates		0⅞
Height from rail to centre line	6	7
Tubes (brass); No. 104; 10 and 12 B. W. G.		
Diameter, outside		2
Distance, centre to centre		2⅛
Distance between tube plates	10	6⅞
Firebox shell (Lowmoor plates);		
Length, outside	5	7
Width, outside, at centre line, 4 ft. 1 in; at bottom	3	8½
Thickness of plates		0⅝
Firebox (copper);		
Length, inside, at top, 4 ft. 10⅛ in.; at bottom	5	0
Width, inside, at centre line, 3 ft. 4½ in.; at bottom	3	2
Thickness		0½
Smokestack.		
Height above rails	12	6
Diameter, inside, at top, 16¾ ins.; at bottom	1	1⅝
Blast pipe, diameter of top opening		5¾
Frames, inside (iron).		
Thickness of plates		⅞
Distance apart	3	9½
Max. and min. depth, 1 ft. 7⅛ ins.	1	2
Cylinders, inclined 1 in 9	17 ins. ×	24
Centre to centre	6	0
Driving wheels, diameter	5	9½
Driving axle journals, length, 8 ins.; diameter		7
Truck wheels, diameter	3	0
Truck axle journals, length, 7 ins.; diameter		4¾
Centre of truck pin to driving axle	9	11
Driving wheel base	8	10
Truck wheel base	4	0
Length of engine, over spring buffers	32	9
Breadth of engine	8	9

The safety valves are of Ramsbottom's type, set at 130 lbs. The valve gear is of Allan's type. The slide valves are of phosphor bronze, steel slide bars, cast-iron slide blocks, iron connecting and coupling rods, steel tires, steel driving and trailing axles, iron truck axles. The compensating beams are 5 ft. 4 ins. long, center to center. The side tanks are 15 ft. 6 ins. long, 2 ft. 2 ins. wide, 3 ft. 6 ins. high; their capacity is 1,200 galls. The coal bunker is 2 ft. long, 8 ft. 7½ ins. wide, 3 ft. 7¾ ins. high; its capacity is 3,024 lbs.

Heating surface:	Sq. ft.	Sq. in.
Firebox	90	21
Tubes	902	139
Total	993	16
Grate area	15	110
Weight in working order:		Pounds.
Truck		24,304
Driving wheels		40,432
Trailing wheels		39 424
Total		104,160

A New Type of Pneumatic Railway.

The ingenious invention of which we present illustrations herewith seems to mark an important advance in a direction in which many inventors worked a half century ago, but in which little of importance has been done for many years. We cannot pretend to prophesy either success or failure for the new invention, except that it will doubtless fall far below the expectations of the inventor, and may possibly rise far above the fate which the majority of engineers are apt to prophesy for complicated innovations on established practice.

The early history of the pneumatic railway is of such interest in this connection, as it serves to make clear the improvement which the inventor of this device has effected, that we preface a description of the device with a brief outline of the past progress in this line, and the partial success which at one time rewarded two of the earliest inventors.

It is difficult, indeed, for those who are accustomed to consider the steam locomotive as the usual and most economical mechanism for operating railways to recognize the great prejudice and opposition with which the locomotive was regarded in its early days. Notwithstanding the great success of the "Rocket" in 1829, popular feeling was strong against the heavy, noisy, smoke-making locomotive; and for nearly a score of years many inventors busied themselves on schemes for operating railways with some form of motor which should avoid the many disagreeable features and defects inherent in the locomotive, and at the same time prove a more economical motor. It is to be remembered that in those early days the locomotive was very far from being the well-designed and perfected mechanism which it is to-day; and, moreover, the minor annoyances of smoke, cinders, dust and noise which we are now accustomed to consider as inseparable from railway travel in some moderate degree, were then wholly novel, as drawbacks to the pleasure of a journey; and like every innovation on established practice, these and other difficulties were much magnified in the popular estimation.

One of the schemes for railway motive power which was followed with greatest persistence by many inventors was the pneumatic railway. The properties of air, when confined under moderate pressure or a partial vacuum, were among the physical phenomena most familiar to the early scientists, and before the close of the eighteenth century we find accounts of the modern pneumatic transmission system being experimented with as a scientific toy only on a small scale. MEELHURST, a Danish engineer, in 1810, and VALLANCE, an Englishman, in 1824, proposed to apply this principle to the transport of passengers and freight through a tube about 7 ft. in diameter. In 1827 the latter inventor abandoned this idea, and proposed to run his carriage on ordinary rails. Beneath these was to be placed a tube containing a piston; and by connecting the carriage to the piston the former was to be propelled by the air pressure on the latter. On this principle most of the later inventors of pneumatic railways have worked, although the New Yorker has only to go back to about 1875 to remember when immense pneumatic tunnels were projected and actually started under Broadway.

The great difficulty encountered by all who have experimented on the tube type has been to secure a practical mechanical connection between the moving piston inside the tube and the carriage outside. With a single piston this would be practically impossible; but, by using a double piston, the space between the two may be open to the outer air, thus giving space for mechanism to open and close the longitudinal slot in which the shank connecting the carriage to the piston passes.

VALLANCE'S invention of 1827, however was crude and wholly impracticable. In 1834 PINKUS, an American residing in London, patented an improvement in which a flexible elastic cord for closing the slot in the tube took the place of the "water seal" used by VALLANCE. This idea was improved and reduced to practice four years later by CLEGG and SAMUDA, who contrived a leather valve for closing the slot, made air-tight by falling in a groove containing a mixture of beeswax and tallow. Experiments with this system were made on models at Chaillot, at Havre and near London, with such success that Mr. PIM, Chairman of the Dublin & Kingstown Ry., was persuaded to put the system into operation between Kingstown and Dalkey, Ireland, a distance of 1¾ miles, where it remained in use from 1844 to 1855. The tube was 15 ins. in diameter, and trains were run at speeds as high as 60 miles per hour The system was also applied to the railways from London to Croydon, from Plymouth to Exeter, and at St. Germain, France, where it remained in operation from 1847 to 1862.

The partial success of this device was enough to stimulate inventors; who hoped for as great rewards, as they viewed the rapid spread of railways, as does the modern inventor of automatic car couplers when he examines the statistics of the total rolling stock in the United States. Especially in the years 1844 to 1847 were their hopes high; and a multitude of devices were proposed for solving the problem. After that date, however, the increasing popularity of the steam locomotive, together with the fact that the ground had been pretty thoroughly worked over, sufficed to deter most inventors from further experiment in this direction.

The accompanying illustrations, however, show the work of a modern inventor who is not deterred by the failure of his predecessors of a half century ago. The details of this system have been worked out very creditably. The chief novel feature of the system of course, and the one on which the inventor bases his hopes of success, is the method of closing the slot in the tube. He has dispensed with the various elastic contrivances of former days as wholly unsuited for the hard work of modern railroading. His mechanism may be easily understood on reference to the drawings.

As will be there seen, the slot in the tube is opened and closed by plates sliding at right angles to the axis of the tube, in a horizontal plane. Each plate is 6 ins. in length, and a rib cast on its upper surface guides it in a straight line in its travel back and forth. On each plate is a round pin by which it is moved back and forth on its seat. The shank which attaches the car to the moving piston carries a plate with a curved slot (seen most clearly in the plan view) which engages with these pins as the car moves, drawing them to one side in advance of the shank, and pushing them back again, so as to close the slot just behind the shank. The plates are lubricated with tallow, and though it might be expected that they would be exceedingly leaky and noisy, these difficulties are not noticeable in the plant at present erected.

To stop the car the arm which extends up through the slot, in front of the main shank, is lowered. This opens valves in the piston heads, and permits

the air to pass through the hollow central tube without escaping into the atmosphere, thus equalizing the pressure on the front and rear pistons. The tube is made complete in 3 ft. sections, so that any section may be easily removed for repairs.

The inventor of the system, Mr. C. H. GOEBEL, has placed an exhibition plant in operation at 607 Chestnut St., Philadelphia, consisting of a car with a capacity for about 15 passengers, running on a track about 80 ft. in length. The tube used was made from the drawings given herewith. The mechanical details have been carefully worked out, and it must be said that in this exhibition plant the system works surprisingly well. It will repay any of our readers who happen to be in the vicinity to step in and take a ride on the car, for merely to see how this invention has been carried to a degree of success in the face of seemingly insurmountable obstacles should interest any engineer.

But while the ingenuity the inventor has shown is interesting and most commendable, one must smile at the extravagant claims which are made for the system. Like many other people whom we have seen engaged in pushing new inventions or new enterprises, by claiming too much, he throws discredit on his whole scheme. Not content with urging its application to any one particular department of work, he proposes to revolutionize the whole railway system by his new invention, and apply it to the trunk line railways as well as to tramways in city streets. Great stress is laid on the possibilities of the system in the matter of speed, and the inventor declares that cars driven by his system will yet make the trip from New York to Philadelphia in half an hour. This would require a speed of 180 miles per hour, or 15,840 ft. per minute or 264 ft. per second! One naturally is tempted to wonder what material he would use for his piston packing to endure a 90-mile slide at this speed without burning up or melting!

It will require but little examination of the system to convince any engineer that it is as little able to compete with the locomotive as a motor on ordinary railways as the crude systems of a half century ago were unable to compete with the locomotives of STEPHENSON'S time.

For use on ordinary street roads, however, the conditions are entirely different; and it is by no means certain that the invention should not be taken seriously, and upon a careful examination, it may prove to be worth a fair trial as a system which may possibly be able to compete with the cables or electric systems. Some points, like the amount of loss of power by leakage in a tube under actual conditions of service, can only be determined by such trial; but let us suppose that the mechanism for opening and closing the slot works as successfully in daily use as it does on short exhibition lines, and see what are the possibilities of the invention. In the first place, it is manifestly unfitted for single-track roads, or those having a light traffic. The inventor estimates the cost of the system at $25,000 to $30,000 per mile. Evidently, then, it is only suited to roads which have such a heavy traffic that they can afford to introduce either the cable or the electric systems.

It will be seen on a little thought that, leaving out of consideration the details of mechanism employed, the pneumatic system is closely analogous to the cable system in many ways. Each possesses a great advantage for roads having many steep grades, in that the power is not wasted when running down hill. In the cable system a flexible endless cord is set in motion by the engine. In the pneumatic system we have a column of air in place of the cord, which, acted on at one point by the engine, transmits the power to each car on the line. The air column, however, is exceedingly elastic, compared to the cable, so that the motion of a car would be considerably influenced by the starting of a car at any point along the circuit. It would not probably be feasible, therefore, to run as long circuits from a single central station as can be run by the cable system. The start of a car by the pneumatic system would be somewhat slower than by the cable system, but provided it were not too slow, this would be an advantage, the sudden jerk with which a cable car starts being one of its disagreeable features. Undoubtedly the entire absence of noise in the pneumatic system would go a long way toward bringing it into public favor. Again, while the cable system is by no means dangerous, cases have occurred in which a broken strand of the cable caused serious accident, and other casualties due to failures of the grip-operating mechanism, though rare, do sometimes occur. From such accidents the pneumatic system would be free, and as it does not appear to be more subject to failure in other directions, it may be set down as safer on the whole than the cable system.

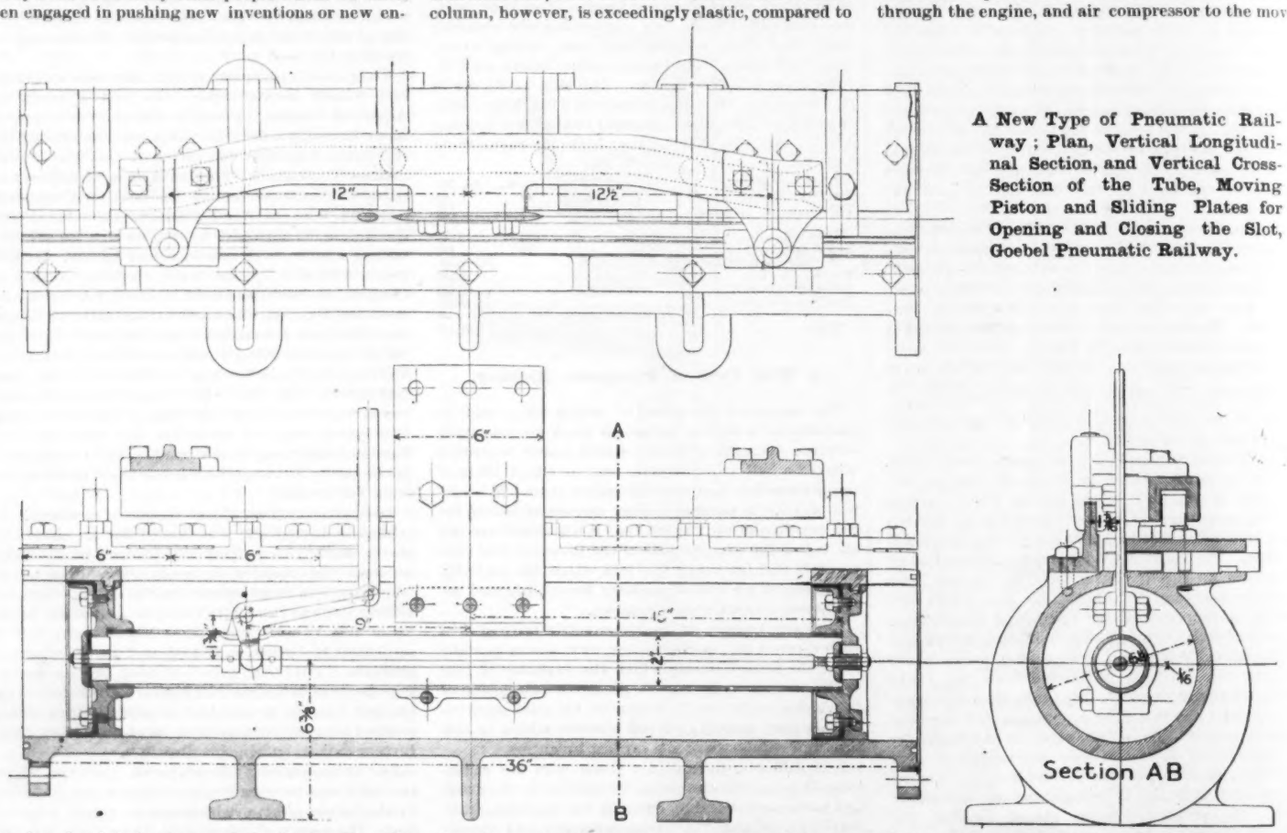
Comparing the two systems in point of expense, the first cost of the pneumatic system would certainly be largely in excess of the cable system. The inventor of the pneumatic system gives $25,000 or $30,000 per mile as a rough estimate of its cost. The greater cost of the tube and conduit of the pneumatic system is offset to a certain extent, however, by the less cost of the plant at the central station, and the smaller area required for its accommodation.

Against this increased first cost of the pneumatic system we may set the fact that its operating expenses promise to be far below those of the cable railway as regards motor power, cost of maintenance of fixed plant, and cost of supervising and operating track. The saving is most evident as regards the motive power. In the cable system a great percentage of the power, frequently more than half, is expended in keeping the cable in motion, which expenditure is constant whether the traffic is light or heavy. In the pneumatic system the moving column of air, which takes the place of the cable, is practically frictionless, and no more power need be applied to it than is necessary to move the cars on the line. Thus during, probably, 12 hours of the 24, the main engine could be stopped and a much smaller engine put in service which would work with greater economy. This would give also advantages similar to those of the duplicate motive power plant of a cable railway and at a much less expense.

The loss in power in transmission from the boiler through the engine, and air compressor to the moving air column, might, perhaps, be somewhat greater than the loss in the cable system between boiler and cable; but as air of a low pressure would be used in the conduit, it does not seem likely that this loss would be much greater than in the cable system, and it might even be less.

It need scarcely be said that in order to come to a definite conclusion as to the real value of the pneumatic system, and its economy in actual use, the above rough comparisons should be made as exact as all the available data in the hands of a competent engineer would permit. In the mean time we present the device merely as an ingenious invention, in a direction in which little of importance has been done for a half century; and which, while it has a multitude of chances of total failure through defects of mechanical detail as yet not apparent, and a failure to secure an economy which is as yet uncertain, has also at least a fighting chance of reaching a success as great as that which the cable system has achieved. There is nothing new under the sun, but so far as we know the method of opening and closing the slot is a distinct advance.

A particularly promising field for the device would appear to be on elevated railways, where it might have all the advantages of the cable, which is beginning to be looked at longingly, while admitting a higher speed, etc.



A New Type of Pneumatic Railway; Plan, Vertical Longitudinal Section, and Vertical Cross-Section of the Tube, Moving Piston and Sliding Plates for Opening and Closing the Slot, Goebel Pneumatic Railway.

A Proposed System of Highway Bridge Supervision for the State of New York.

BY CHAS. F. STOWELL, M. AM. SOC. C. E.

The defects of the present system, or lack of system, in the building and supervision of highway bridges have been pointed out from time to time for years. After every bridge failure of any magnitude, the press, especially the engineering press, calls attention to the dangerous and irresponsible method in which such work is frequently performed. But after the first excitement has worn off the subject is speedily forgotten until some new disaster brings it again into prominence.

The present system is unsatisfactory and dangerous because it leaves the building of bridges in the hands of men who know absolutely nothing about the subject—men who in a great majority of cases do not even know enough to realize that they are ignorant, and men not infrequently whose character bears no comparison to that of Cæsar's wife. There are men chosen for highway commissioners who have seen enough to realize that in so intricate a matter as building a bridge they need the assistance of some one who understands the subject, and honest enough to refuse the perquisites by which many a bridge contract is secured. But such commissioners are rare, and even when one is found he is too often overruled and outvoted by more ignorant or less scrupulous fellow-officers. This state of affairs furnishes the opportunity for the unscrupulous bridge builder to get in his "fine work." There are certain bridge companies—every one in the business knows them—who always urge highway commissioners to have nothing to do with engineers.

The agents of these companies, shrewd fellows with glib tongues, will impress upon highway commissioners that all engineers are humbugs and purchaseable. That it is a mere waste of money to employ one; in fact, worse than a waste, for, being purchaseable, as they all are, any company which secures a contract subject to an engineer's approval necessarily must "grease" him in order to get their bridge accepted, and therefore cannot afford to put as much money into the bridge itself as if this item of expense did not exist. A certain bridge agent, who does a thriving business in this State, boasts to highway commissioners that his company has built 95 per cent. of all the highway bridges in New England, and has never had a bridge examined by an engineer who did not condemn it. And he adds that they are proud of it. Perhaps a part of his statement is true.

These agents tell highway commissioners that it requires no special training to tell a good bridge from a bad one; that any man of common sense "like you" can do it, and that all that is necessary to get a good bridge is to have a rigidly drawn contract "like ours," with a reliable firm "like us." Such talk too frequently carries the day and the company goes on to build under a contract of its own, making just as poor a structure as the elasticity of its conscience will permit, knowing that, no matter how it may violate the provisions of its own contract, there is not one chance in a hundred of the fact ever being discovered, and not one in a thousand of the company losing anything by it.

A favorite practice of these gentry is to invite highway commissioners to go about the country at their company's expense to "see some of our bridges.' Such a trip furnishes the best possible opportunity for a bridge agent to present his most persuasive arguments. The bribe of a free excursion, often backed by more substantial considerations, frequently fetches a contract even at a considerably higher figure than that of more scrupulous or less energetic bidders. At a recent bridge letting in this State there were thirty-two bids received. As soon as they were opened one of the agents present invited the commissioners to take an excursion of some hundreds of miles, to see some of his company's work before awarding the contract. The invitation was accepted by a majority of the commissioners. What passed between them on the trip is known only to the parties themselves and the Deity. But immediately upon their return they promptly awarded the contract to their host over twenty-two lower bids, and at a price forty-four per cent. above the lowest.

Moreover, they refused to employ any engineer to supervise the work, and when asked for a reason one of them said: "The commissioners came to the conclusion that so much had been said in relation to the honesty and dishonesty of experts and engineers that we embodied in the contract that the bridge should be tested by the contractors by loading the bridge with a certain weight and rolling a sixteen-ton load over and back, and any apparent damage done by either the weight or rolling load to be sufficient cause for rejecting the bridge." Such is the way in which bridge contracts are made, and bridges built in this State. Any bridge company which offers a bribe contemplates rascality. Any bridge company which offers to take highway commissioners on an excursion "to see some of our bridges" designs to perpetrate a fraud. But when in addition to securing a contract by fraud a bridge company persuades the commissioners to allow no engineer to check its plans or oversee its work, it certainly intends beyond a doubt to swindle its patron to the utmost extent possible. There are companies which employ these tactics regularly, every day; companies making pretensions to respectability too, and some of whose officers are members of the American Society of Civil Engineers. Every one who attends highway bridge lettings knows them.

The contract usually drawn up by such parties states the loads which the bridge is to carry, but carefully omits all reference to unit stresses or factors of safety, so that while the loads are frequently ample they skin down the weight by figuring for excessively high unit stresses. Then, if any one ever does happen to question the capacity of the bridge, the builders will reply that they never intended to use the ordinary factors of safety, but are perfectly willing to let the bridge be loaded up to the amount contracted for, and if it falls charge nothing for it. A large bridge was built in this way about a year ago in a certain village in this State. A majority of the commissioners had been taken on a junketing trip by one of the competing bridge companies. On their return they awarded the contract to this company, over the heads of half a dozen lower bidders, and upon this company's recommendation decided to dispense with the services of engineers and inspectors. But certain taxpayers were not satisfied with this manner of doing business, and upon the completion of the bridge decided to have it looked over by a bridge engineer for their own satisfaction. This was done, and the bridge reported to be about 33 per cent. too light for the loads specified in the contract. Did the builders weaken at this? Not at all. "We agreed," said they, "to build you a bridge which would carry so many pounds per square foot. There it is. Load it to that amount if you choose. If it falls it is ours; if not, then the bridge is yours, and you shall pay us for it." This logic carried the day, and the bridge was accepted. The average citizen does not understand the utter uselessness of such a test.

Sometimes a bridge company will furnish a strain diagram, which, on its face, appears to be all right. The loads are right and the sections ample for the stresses given. But if the stresses are checked it will be found that they are computed for altogether different and much lighter loads than those given. This trick, of course, can only be safely employed when it is pretty certain the strain sheet will never be subjected to an engineer's scrutiny. Though even should such a strain sheet unexpectedly get into an engineer's hands and the trick be exposed, still it need not necessarily forfeit the bridge company's chances of getting the contract if the proper precautions have been taken. At a bridge letting in the southern part of this State not many months ago one of the bidders put in a doctored strain and section sheet of this sort. The suspicion in the public mind of crooked dealing, however, was so strong that before the award was made the commissioners thought it would be wise to get an expert's opinion on the bids and plans. This being done, the cheat was, of course, at once discovered and exposed. But so well had the commissioners been fixed that after hearing the expert's report a majority of them immediately awarded the contract to the very company whose rascality had just been published.

How can this scandalous state of affairs be corrected? If it were only a matter of dollars and cents which a community is cheated out of by a sharp bridge builder, perhaps it would hardly be worth correcting. A community which deliberately elects ignorant or dishonest officials to represent it in important business transactions usually deserves and receives little sympathy when it gets cheated thereby. It is not on account of the queer financial transactions so often involved that this business needs purifying, but because it is a matter involving the safety of the life and limb of every one who has occasion to cross a highway bridge. For this reason these bridges ought to be placed under some sort of competent supervision. The State should require all public bridges to be built and maintained up to a certain standard as regards strength, and should see that its requirements are carried out. The correction of the financial abuses connected with bridge lettings would follow as a collateral result.

Not only should the State exercise supervision over new bridges as they are built, but it ought also to take cognizance of all structures heretofore erected and now in use and enforce the rebuilding or strengthening of dangerous ones whenever found. There is in a city in the northern part of this State an important bridge in daily use for heavy traffic which is liable at any time to be strained uncomfortably close to its breaking point. It will certainly go down some time. It is liable to fall any time. It would be hard to estimate the number of other such bridges in this State which are only waiting for the last straw which will break the camel's back, but which are in daily use by thousands of persons absolutely ignorant and unsuspicious of the danger incurred whenever they cross.

Several plans have been suggested for erecting this state of affairs. It was thought that a pool of highway bridge builders would be an effectual remedy for controlling the prices and apportioning the work equitably among its members so that there would not be that incentive to do inferior work in order to save a builder from loss which often existed under the cut-throat methods previously in vogue. The pool has been tried, but its workings have not been altogether satisfactory. On the one hand, it has encouraged the formation of a brood of small-fry bridge companies which have been taken into the pool to prevent them from becoming troublesome parasites outside of it, and whose chief means of subsistence are their percentages on the work which other companies perform. On the other hand, it frequently happens that a letting which had been all fixed by the pool is turned into a "free-for-all" contest on account of the unexpected presence of some outside bidder; and the more desirable the contract the more likely is the work of the pool thus to be nullified.

Another proposed plan is to divide up the State into districts, and appoint some supervising engineer in each district to take charge of all bridge construction therein, his pay to consist of fees fixed by law. The method is sufficiently cumbersome, truly.

It has been proposed that every company building a bridge should be obliged to place on it a tablet giving the name of builder, date, dead and moving loads used in the computations, safety factor, etc. This might possibly be productive of some good, provided means could be devised at the same time to prevent unscrupulous builders from lying and to insure the use of well-designed details. Otherwise it would not amount to much.

[TO BE CONTINUED.]

The Proposed Lakes Superior and Michigan Canal.

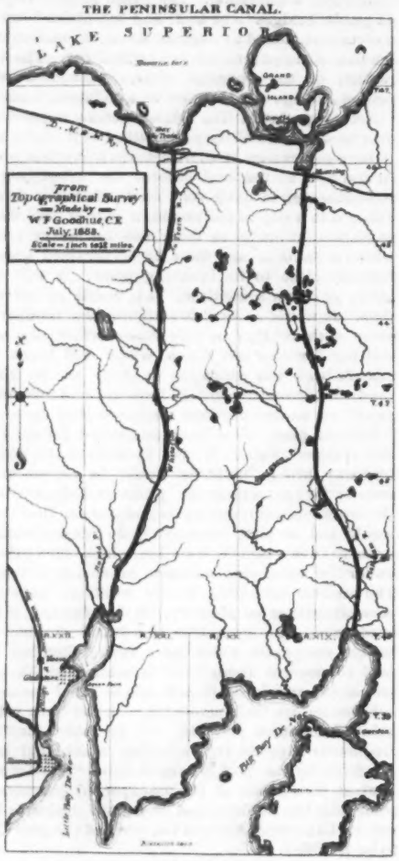
As the canal proposed for uniting the waters of Lakes Superior and Michigan involves wide-spread interests, we present in this issue maps of the routes suggested and some notes on the same, for which we are in part indebted to Mr. W. F. GOODHUE, C. E., of Milwaukee, Wis.

A glance at the map of Michigan Peninsular shows how a canal cutting across from Green Bay to Lake Superior would save a very considerable and important distance as compared with the route via Lake Huron and the Sault Ste. Marie. The gain in time would mean 2½ days for an ordinary steamer and five days for sailing craft.

As shown, there are two proposed routes for this canal; but by either route the length of the canal would be about 36 miles. A width of 60 ft. is recommended at the start, to be widened as the development of lake traffic might afterward require. A depth of 20 ft. would be sufficient for the passage of all heavily-loaded vessels. The harbor at the northern end of the western route is badly exposed to lake storms, but protective works could be built with the

rock excavated from the canal. The eastern line is somewhat shorter for vessels sailing from Lake Michigan to Lake Superior ports; but as it does not utilize the beds of rivers, it would be more expensive to construct than the western route. On the other hand, there is less rock to blast on the eastern

THE PENINSULAR CANAL.



Detail Map.

line, and it has very excessinle harbors at both ends, with the northern entrance admirably protected by Grand Isle. Mr. GOODHUE, who has made these surveys and has been prominently connected with this project since 1883, estimates the cost of a canal at this point as between $8,000,000 and $10,000,000.

The history of this proposed canal, briefly stated, commences in 1883, when Mr. GOODHUE, while making surveys in the Upper Peninsula, had his attention forcibly directed toward the matter of lake routes and the possibility of saving 271 miles in the distance between Ashland and Duluth and Milwaukee and Chicago. Mr. GOODHUE then planned a thorough exploration of the country in question, and succeeded in interesting capitalists in the scheme, the most active of the capitalists being Mr. W. H. MORRELL, of New York.

This is the canal for which Congressman S. M. STEPHENSON, of Menominee, Mich., has lately asked an appropriation of $50,000 for a complete and thorough survey of the two routes suggested. The legislatures of Minnesota, Michigan, Wisconsin, Illinois, and Indiana have already sent in memorials asking Congress to make this appropriation, and the maps here produced are copies of those furnished with these memorials.

The Lake Superior and Lake Michigan ports are deeply interested, and the late establishment of shipbuilding yards in that section has given renewed impetus to the project. There is a rapidly growing demand for shorter water-ways in the upper lake region, and the schemes lately proposed for the benefit of the Dominion of Canada have made it very apparent that something must be done quickly on our side to counteract what may prove an important diversion of traffic from American lake ports. Among these schemes the Dominion proposes to dig a canal from Lake Ontario to the Georgian Bay, via Lakes Trout and Simcoe, with a still greater project, in the air as yet, for a canal from the Georgian Bay to Montreal, via the Ottawa River and Lake Nipissing. Though the proposed Michigan-Superior canal has enemies in the lower lakes, and Detroit, Cleveland and Buffalo claim that they would be injuriously affected by its construction, it would seem that the Canadian canals would affect them still more seriously, if ever finished on the lines now proposed. While these canals could not be said to compete with the one here described, the further development of direct and practical water-ways on our side of the line will enable us to hold and still further control a full share of lake traffic, even if the Canadian canals were completed. From this point of view the lower lake ports are quite as much interested in the proposed canal, or any other extension of present facilities, as are the Northwestern States now applying to Congress.

General Map.

The main bill for improving the State highways provides that the Governor, Lieutenant-Governor and State Commissioner (to be appointed) shall constitute a State Board of Highways and Bridges. But until 1891 this board shall be increased by the addition of five members, one from each county, two of whom shall be practical, experienced civil engineers. This State board is to select, designate, lay out and describe the highways best suited for improvement and maintenance among the roads of the State. This board is to report these selected highways in January, 1891, together with maps, specifications, estimated cost, etc. This annual selection of roads must be approved by a majority of the Senate and House.

Such improved State highways shall not include any roads within the boundaries of any present or future city, and plans, records and profiles must be open to the reasonable inspection of citizens. The State board shall award damages for land taken or from changes in grade, but three-fourths of this damage, and no more, may be assessed upon such owners that the board shall find to be especially benefited by the improvement. Any person aggrieved by such award may appeal, as is now provided by law in the case of highways controlled by town councils.

The location, re-location, change in width or grade, construction, maintenance, and control of these improved highways will be wholly within the control of the State board; and as fast as they are constructed they shall be taken out of the hands of the town authorities now in power over them. The cost of construction and maintenance is to be uniformly opportioned as follows: Two-thirds shall be paid by the State, and one-third of the cost of construction and maintenance of that part of the improved highways located within the boundaries of any town shall be paid by said town. (It should be noted here that "a town" in Rhode Island is the equivalent of "a township" in other States; it is a geographical area and not simply an agregation of buildings.—ED.) The amount due from any town is to be certified by the State board to the town treasurer; and shall be payable to the general or State treasurer within 6 months, under penalty of a suit against the town brought by the general treasurer. The citizens of the town may pay their assessment by levying a tax, or by issuing town bonds in denominations not exceeding $500 and payable in 10 years.

All work of construction shall be done by contract on sealed proposals, after due advertisement issued by the State board. A form of "notice to contractors" forms a part of the bill submitted.

The act to regulate the repairs on highways and bridges is an amendment of and an addition to an existing act. According to its terms each town shall constitute a highway district, and all highways and roads *not* coming under those before designated as State highways, and thus put under the State board, shall be in the control of a surveyor of highways, elected for 3 years by the town council. The remainder of the new act relates to changes in the old laws to be made necessary by the passage of the State highway law.

The State Commissioners of Highways and Bridges is to be nominated and appointed by the Governor with the advice and consent of the Senate, and shall hold office for 5 years, or until his successor is qualified. The commissioner must be "a practical and experienced civil engineer," and shall receive as his annual compensation $2,500 and reasonable traveling expenses to an amount not exceeding $400. He may employ a clerk at $800, and hire office room in Providence at an annual expense not exceeding $500.

His duties would be to annually inspect such public highways, bridges, etc., as he deems best; to have maps of all the public highways, bridges, etc., in the State; he shall annually, in November, call a meeting at his office of all town and city surveyors of highways for the purpose of conference and discussion, and he shall at all times give, free of charge, any advice or information requested by the surveyors mentioned pertaining to the duties of their office. He must report in January of each year to the General Assembly as to the condition of the improved highways, the economic conditions and general results following their improvement and make such recommendations as he may see fit.

The act relating to the width of wagon tires suggests a form for this regulation without absolutely fixing dimensions. The guide-board act calls for the erection and maintenance by the town councils of a guide post not less than 8 ft. high, and with the name of and the distance to the next town plainly marked thereon, at every necessary and convenient place.

Highway Reform in Rhode Island.

The improvement of country roads is just now a live subject in Rhode Island, and the R. I. State Roads Improvement Association, the Gentlemen's Riding Club, and the R. I. Div. League of American Wheelmen are especially active in this direction.

The associations here named have combined to frame and present to the General Assembly a series of acts providing for the repair of highways and bridges, improved State highways, the appointment

Reservoir "M" on Titicus River, New York Water Supply.

(WITH INSET.)

The dam and its appurtenances illustrated in this issue are connected with the so-called Reservoir "M" now being constructed on the Titicus River, near Purdy's Station, in the town of North Salem, Westchester Co., N. Y. It will form one of the several storage basins built and to be built for the increased water supply of New York City. The dam is designed by and its erection is under the direction of Mr. A. FTELEY, C. E., Chief Engineer of the New Croton Aqueduct Commission, to whom we are indebted for the use of the originals.

The location of the dam is somewhat peculiar, as is shown on the plan; and while the main portion is masonry, an earthen embankment with a masonry core is connected with it, mainly as a reinforcement to the somewhat narrow spur that juts out from one side of the valley.

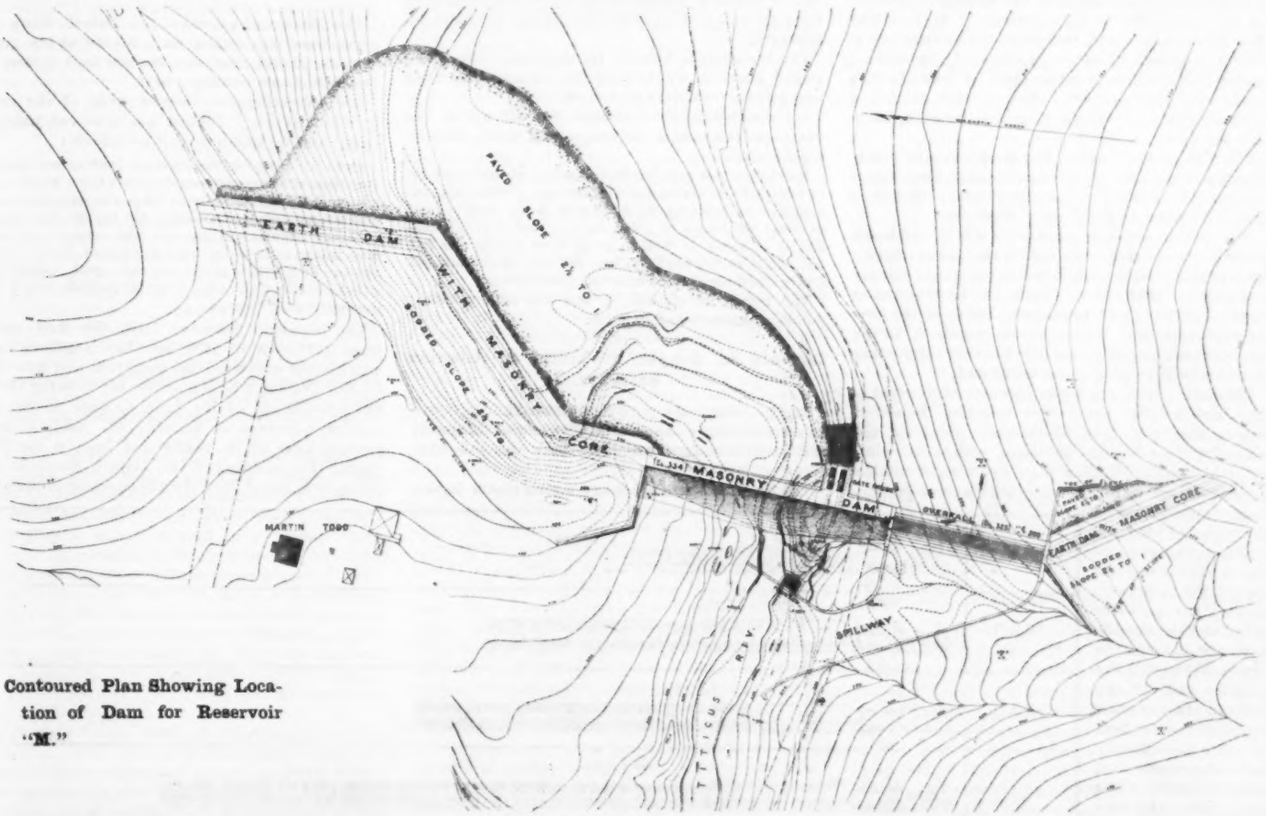
The general design and dimensions of the several parts of this dam are so plainly indicated on the views given that little description is necessary. The embankment work is to start from a well-prepared base, stepped on sloping ground, and carried up in horizontal layers not exceeding 6 ins. in thickness; every layer is watered and carefully rolled with a heavy grooved roller. Special care is taken with the earth abutting against the centre wall, and as a rule the embankment at this point will be always kept about 2 ft. higher than the adjoining earthwork, and the embankment on both sides of this wall must be kept at a uniform height during construction.

All masonry, excepting some dry rubble walls and paving, is laid in American and Portland hydraulic cement, with all work well and thoroughly bonded, with joints entirely filled with mortar so as to be absolutely water-tight. As a rule no masonry is to be laid between Nov. 15 and April 15. The slopes which are to receive the paving are covered with 12 ins. of broken stone, not exceeding 2 ins. in their greatest diameter, as a foundation for this paving.

The central part of the dam will be rubble stone masonry, built of sound, clean stone of suitable size, with good beds and laid with full mortar joints; no grouting or filling of joints after the stones are in place will be permitted. It is expected that the largest stones used in the central part of the dam and overflow will not exceed 20 cu. ft. in size, and about one-quarter of the stone used will be "two-men" stone, with the balance composed of intermediate sizes. This same class of wall practically will be used for the core-wall in the earthen embankment. All regular coursing is to be avoided. The exposed faces of the wing-walls, retaining walls, etc., will be made of broken-range ashlar, with a ½-in. joint as a maximum and no course less than 12 in. deep.

As shown, heavy block-stone masonry is to be used for the overfall and top and back of the central part of the draw, and wherever steps are to be employed. As this masonry must receive the shock of water and ice the stone used will be especially sound, hard, compact and durable. These stones are prepared to dimensions given by the engineers, with an allowance not exceeding one inch for joints.

The contract for the execution of this work was let last month to Washburn, Shaler & Washburn for $933,065, the contract including the masonry and earthen dams, and gate-house and appurtenances complete. The "probable estimate" of the engineering department was $1,151,195. A full list of the detailed bids was given in our issue of Feb. 15 last.



Contoured Plan Showing Location of Dam for Reservoir "M."

The Fales Furnace.

Exhibitions are being held in Boston of a new furnace, the invention of Mr. EDWARD FALES, of Philadelphia, which appear to demonstrate remarkable and almost startling results.

The claim is made that coal or fuel of any kind may be burned in this apparatus to "absolute perfection," and that a new principle of combustion has been discovered and is embodied in it. Patents have been granted by the United States and other governments on the process which constitute method patents, a kind which are extremely rare. It is said this is but the fifth method patent ever granted by the U. S. Patent Office, and the first and only one relating to combustion.

By invitation the Boston correspondent of ENGINEERING NEWS was present, in company with a score or two of furnace men, engineers, scientists, and others, at one of these exhibitions, and, although skeptically inclined, especially when such wild claims were made as that 20 lbs. of water could be evaporated by this apparatus per pound of coal burned (the theoretical evaporative efficiency of the best coal, [illegible] and at 212°, being only 12 to 13 lbs.), he was greatly interested in the facts developed, which did not extend to evaporative tests, but were as follows:

The first furnace or stove shown consisted of a fire pot of unlined cast iron, about 30 ins. in diameter, and surmounted by a heating or radiating drum consisting of a cylinder of sheet iron, closed at the top. The air is admitted underneath the grate, and the products of combustion are conducted to the chimney by a stove pipe leading from the drum above the grate, as in ordinary stove or furnace construction. The only novelty consists in the form or arrangement of the grate. This is extremely simple, also, and may be represented in form by a hat placed with crown down. The shape is circular, and in the crown of the hat conceive a circular grate, and 5 ins. vertically above this level, another annular grate in the rim of the hat. Coal was put in upon the grate to a depth of about 10 ins. upon the lower or middle grate, which caused the depth to be about 5 ins. upon the upper or annular grate. Kindling wood being placed on top of the bed of coal, a fire was lighted, the fire door closed and the ash-pit door opened for draught. In about four minutes time the drum of the stove began to grow red, and a roaring began, which indicated a draught almost like a cyclone to have been created inside, and the entire stove became red-hot. By adjusting the ash-pit door the combustion was controlled, and on opening the fire-door the peculiar operation ceased. A paper placed in the ash-pit revolved, showing a whirling current of air to have been generated, and while in full operation the hand could be placed upon the lower side of the middle grate, which was perfectly cool. The active combustion appears to take place around the edges of the furnace. So intense was the heat generated that pieces of cast iron and even spiegel placed in the bed of coal were melted, and ran through the grate in less than five minutes after they were put in.

Another form of furnace which is entirely new was shown in a fire-brick setting, looking something like an open grate, but having no grate bars beneath, the burning coal resting directly upon the bed of ashes, and being fed downward by gravity, from a magazine above.

The first pot is about 4 ins. wide, from front to back, and as broad as may be necessary for the required capacity of the furnace. It is open in front for the admission of air, vertical bars preventing the coal from falling out. At the back are similar vertical bars, but not extending so high as those in front, and through which the gases are led to a heater and thence to the chimney. The heater is cyclindrical with an outer and inner shell, closed top and bottom, to form a drum, between the sides of which are vertical tubes, open top and bottom, which permit the air from the room to be drawn through them and circulated through the room. The heat given out was intense, and as a heater it was highly successful.

Furnaces for house heating on the principle of the first described heater have been manufactured and have been in operation in Washington for about three years. The present form of stove is about 6 ins. deep by 1 ft. wide and 3 ft. high, and consists almost entirely of the magazine to hold the coal. It has no grate, but vertical bars in front and back form the sides of the combustion chamber.

No one has yet explained the principle involved in the operation of these heaters. It is evident that there is unequal resistance to the passage of the air through the two portions of the furnace owing to the different thicknesses of coal through which the air is drawn. How this can produce a cyclonic action, developing an intense draught, is the mystery.

The furnace will reduce the most refractory substances, spiegel, limestone, furnace slag, even asbestos, in a few minutes. Great economy of fuel is claimed, and an entire absence of smoke.

It is to be hoped that such tests will be made, especially evaporative tests with water, as to afford a basis of comparison with furnaces upon the ordinary principle, so that accurate data may be obtained as to the efficiency and consequent value of the new principle involved. Such tests are promised. In the meantime we can only chronicle the very interesting results which we have so far witnessed.

The cause of the enormous increase of draught is explained by the inventor as follows: It is well known that our present chimney draughts are caused by the column of hot gases within the chimney, which, being lighter than a column of outside air of the same bulk, ascends, with a force proportional to the difference of weight. This force of draught acts to produce a partial vacuum within the chimney, causing the pressure to fall and the outside air to rush through the furnace to equalize the pressure and fill the vacuum. In the brick set Fales furnace there is a space immediately back of the combustion chamber and below the flame. The flame covering the top of this space, he claims, produces in the furnace precisely what is produced in the tall chimney, or a partial vacuum is formed.

We have, then, available for draught, a larger or smaller proportion of the entire pressure of the atmosphere, or 14.7 lbs. per sq. in., according as this vacuum is more or less perfectly formed. The inventor states that with a 10 ft. stove pipe he obtains as good a draught as would be obtained with the tallest chimney, and further, that a 2-in. pipe answers as well for a fire as a 10-in., where that size would ordinarily be required. There are hardly any gases noticeable at the outlet of the chimney and the temperature is but little raised over that of the surrounding air.

COMPARATIVE HOT AIR TESTS.

Report.

BOSTON, March 7, 1890.

A test was recently made between the so-called Novelty furnace and the Fales furnace, before a number of prominent engineers, with the following result:

Area of space heated, 33,826 cu. ft. Length of test, each 24 hours.

	Novelty.	Fales.
Size of combustion chamber	26 in. diam.	7 × 18 in.
Average temperature outside	24 16-23°	21°
Average temperature inside during test	68 5-10°	68 8-10°
12¼ hours on soft coal consumed	252 lbs.	109 lbs.
11¾ hours on hard coal consumed	168 "	54 "
Total	420 lbs.	163 lbs.

At the time of starting the Novelty furnace the temperature outside was 22°, inside 52°, and it took from 9.30 A. M. to 11.23 A. M. (113 minutes, to raise the temperature to 66°.

At the time of starting the Fales furnace the temperature outside was 28°, inside 50°, and it took from 9.30 A. M. to 10.15 A. M. (45 minutes) to get the temperature to 66°.

The Fales device produced a temperature of 66° in 45 minutes from the time the fire was started, whereas the Novelty system required 113 minutes to obtain the same result, thus, although the Fales system ran 63 minutes longer at 66° to 70°, no credit has been given it for this difference on the average temperature.

On March 3 the Novelty furnace was started and run 24 hours; it was then taken down and the room was allowed two days to cool off.

On March 6 the Fales furnace was set up on the same spot, the same chimney being used. The report says:

We notice two very important points of difference between the Fales device and the Novelty. During the consumption of soft coal (the same kind being used by both devices) we found in going on the roof a very dense smoke escaping, as well as great heat, during the box test, while during the Fales test not any smoke, and but a very small per cent. of heat was perceptible.

The report is signed by ten different persons, mostly engineers and experts.

Increase in Length of Trains on Austrian Railways.

On Dec. 7 last, Herr VON HORNBOSTEL delivered an address before the Austrian Society of Engineers and Architects, from which we take the following notes:

"In England there are many trains which have a speed of 52 to 68 miles an hour, in France and Belgium we can travel 50 to 56 miles in the same time, while our fastest trains barely reach 40 miles an hour. It is easy to see, then, that we have much to learn from our neighbors.

"But we must remember that the safety of the train must be guarded while the speed is being increased. I claim that this question of safety prevents our increasing the speed while the roadbed remains in its present condition.

"All roads running faster trains than ours have better tracks. The English engineer lays his heavy rail in large chairs. The French trains run over 92 to 100-lb. rails, and the ties are spaced closer than here. The Belgians have their Goliath rail, 131 lbs. to the yard (65 kilos per meter). Our rails have the following weights per yard:

	Lbs.
Royal State R. R.	71
State R. R.	70.5
King Ferdinand Northern R. R.	70
Southern R. R	69.5
Northwestern R. R.	67

"In the accompanying diagram the growth of our express train is shown. The weight of the train includes that of the locomotive and tender, and the speed is that given on the time tables, thus including stops."

In the discussion that followed the address, Herr BISCHOFF, an imperial councillor and well known engineer, referred to the United States as follows: "I have already stated that we will soon be obliged to adopt the American cars. It is unfortunate that we must look to other countries for a proper model. If we had studied the problem of passenger transportation in the beginning, and not imported the rolling stock of neighboring nations, we might be to-day on a plane with the Americans."

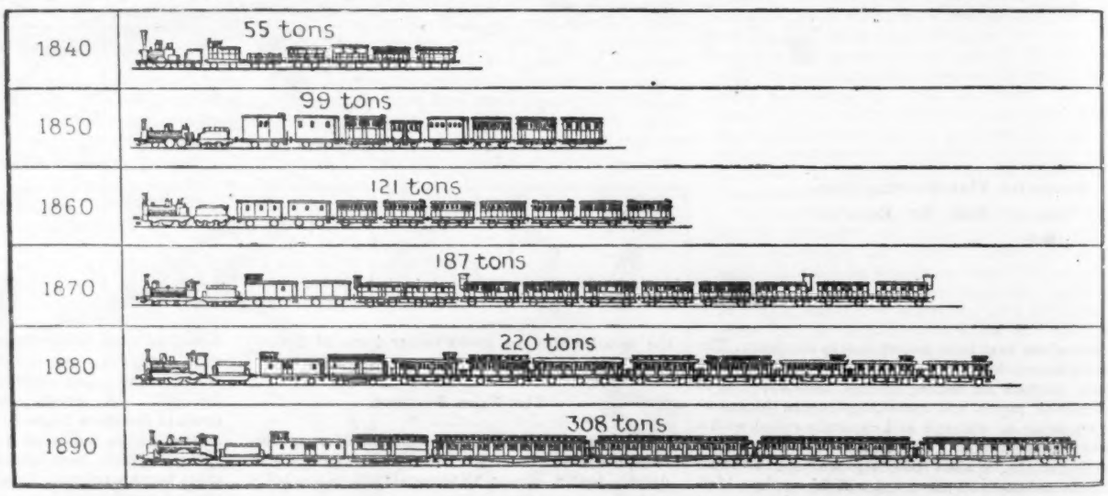


Diagram Showing Increase in Length of Trains on Austrian Railways, 1840 to 1890.

The Growth of Duluth's Commerce.

The illustrated annual of the Duluth *Daily News* gives some interesting facts regarding the growth of "the Zenith city" and the railways and steamer lines which are tributary to it.

An interesting statement is given of the process by which at last "Duluth has achieved independence," and we quote from it as follows:

From the mistaken idea that the railway was master of the whole situation, two grave errors were made by railway men in the Northwest: First, the extension of the systems centering at Chicago far beyond the territory naturally tributary to that city; and, second, the creation of an inland railway terminal point at St. Paul. Chicago and the Twin Cities grew rich and great, while Duluth was denied the right, and, so far as possible, was refused the opportunity to grow.

The historian describes how the first railway came to Duluth in 1870, how the Northern Pacific was started westward the same year and was meant by JAY COOKE, whose mistake lay in being twenty-five years ahead of his time, to have its principal eastern terminus at Duluth. St. Paul, however, secured most of its traffic and kept it for fifteen years. The building of the Duluth, South Shore & Atlantic is called "Duluth's declaration of independence," and this, with the completion of the Duluth extension of the St. Paul, Minneapolis and Manitoba system is believed to have given Duluth the whip hand of her commercial rivals. It is triumphantly recounted how the fight has been carried on and how in the face of the opposition of Minneapolis, St. Paul and Chicago, and the railroad interests centering at each point, victory has at last perched on Duluth's banners. The story is so graphically told that we reprint some further extracts:

Traffic Manager ORR, of the South Shore, took the position that, as that road had the short line between Duluth and the East, it was entitled to make the rates, and proposed to do so. These rates, furthermore, should be more nearly on an equality with those enjoyed by

Chicago, and at least as low as those given to St. Paul. This announcement evoked a storm of opposition from the press of St. Paul and Chicago, and from competing roads. The South Shore road was denounced as a pirate, and a war of rates was inaugurated which was intended to drive the South Shore from the field. But that road calmly maintained its position, and met all cuts with corresponding and still deeper cuts, until the right of the South Shore road to make the rates out of Duluth was conceded.

But mere equality of freight rates did not satisfy the demands of the situation, for Duluth was entitled to more than that.

Upon these great roads, with their millions of capital and thousands of miles of track, the demand now made was, not for a differential rate; not for a percentage of the traffic, however large, but for the absolute surrender of the Northwestern business by the Chicago routes to the Duluth route! Coupled with this was the demand that rates to Duluth should be less than to St. Paul! These demands, involving such revolutionary readjustments of the lines of traffic, and pregnant with such disastrous consequences to the Chicago roads, were received by the managers of those roads with mingled astonishment and indignation. Their indignation continued, but their amazement soon gave way to consternation as it became evident that these demands could and would be enforced.

It was not to be expected, of course, that the Chicago roads would submit without a struggle, and in their desperation they looked in every direction and resorted to every possible expedient for relief. But all their efforts were in vain. The Duluth route was offered 50, 60, even 90 per cent. of the business, but to all these offers only one reply was made, and that was that the Duluth route was entitled to all the business and intended to have it. There was nothing left to be done but succumb to the inevitable with the best grace possible, and so, by a formal vote, the Chicago roads surrendered the great and growing traffic of the Northwest to the Duluth route.

While the opposition to the second demand was less strongly intrenched, it was, nevertheless, bitterly opposed by St. Paul and Minneapolis, and the other lake lines, which had always made the rates to the Twin Cities at least as low as to Duluth. The conflict was lively while it lasted, but the outcome in this case was the same as in the other—the victory rested with Duluth, whose right to commercial supremacy in the Northwest was recognized by the establishment of a lower freight rate than is given to St. Paul, Minneapolis, or any other inland city whatsoever.

The effect of these changes in rates are seen by the statement that grain rates from Omaha to Duluth are now the same as from Omaha to Chicago, and application has even been made to have rates from Kansas City to Duluth reduced to an equality with Chicago. How heavy the business is that is flowing toward Duluth may be seen by the statement of the October traffic of the Eastern Minnesota Railway, the St. Paul, Minneapolis & Manitoba's outlet to Duluth. The gross earnings were $140,000, or $2,000 per mile. The ton mileage for the same time was nearly 16,000,000. During the season of lake navigation the company handled nearly 1,000,000 barrels of flour.

Concerning future railroad construction, a good deal is said. The Duluth & Winnipeg is expected to tap the great wilderness about the head waters of the Mississippi, and bring in an enormous amount of lumber, wheat and iron ore to be shipped at Duluth. The Chicago, Milwaukee & St. Paul is expected to build an extension, leaving the main line at New Lisbon, Wis., and passing through the great pineries on the Chippewa and Flambeau Rivers, to a terminus at Duluth. Other projects mentioned are the Port Arthur, Duluth & Western, to run from Port Arthur through the silver and iron districts to the International boundary, and the Duluth, Red Wing & Southern, which is planned to extend from Duluth to Sioux City, Ia.

Principal interest centres, however, in the prophecy of "a magnificent contest for supremacy" between the Northern Pacific and St. Paul, Minneapolis & Manitoba or Great Northern. We quote as follows:

HENRY VILLARD has signalized his return to the control of the Northern Pacific by a plan for a consolidated mortgage for $160,000,000, which provides more than $50,000,000 for increase of equipment, improvement of terminals and the construction of branch lines. A recent circular issued to the holders of preferred stock says:

"The company must be prepared to build additional feeders wherever and whenever the local developments warrant and the danger of hostile occupancy appear."

The Manitoba will build to the Pacific coast, but before it can possibly complete its Pacific extension the Northern Pacific will have shortened its present line by more than 150 miles. This it will do by building from Missoula to Mullan, completing the Coeur d'Alene line across Idaho and extending the Central Washington branch to Cleelum just east of the Stampede tunnel. The Manitoba is building from Great Falls to the Little Belt Mountains, and the Northern Pacific has surveyed a line from Billings by way of the same mountains to Ft. Benton, which may be extended on across the boundary to the coal mines at Lethbridge. Just what lines will be built in Minnesota and the Dakotas is not yet known, but indications are not lacking that the Northern Pacific means to cut deep into the Manitoba's choicest territory in the Red River Valley, and may run a race with it to the corn country in the Southwest, or across the newly opened Big Sioux reservation to the Black Hills.

The Manitoba has been making preparations for the coming conflict also. As an offset to HENRY VILLARD'S consolidated mortgage, President HILL puts forth the Great Northern Ry. scheme, which will concentrate the Manitoba and all its allied railway and steamship lines under one control and provide the necessary millions for making further extensions. At least two important extensions are to be made at once, however, which will complete the great Montana line westward to the Pacific and eastward from Crookston to Duluth, making this city the terminus of a second transcontinental line. No other extensions have been officially announced, but it is not likely that these are all that will be made. Those which seem most probable are an extension of the Sioux Falls line to a connection with the Burlington system in Nebraska, the extension of the Huron or Aberdeen line to the Black Hills across the Big Sioux reservation, and of the Brown's Valley branch across the Sisseton reservation, both of which are to be opened for settlement.

The secret of Duluth's supremacy lies in her situation at the head of the great lakes, and the facilities thus offered of water transportation for the millions of bushels of grain from northwestern prairies to the markets of the East. A single one of the great steel propellers, which ply between Duluth and Buffalo, carries a cargo of 2,700 tons, moves at nearly the speed of a freight train; and, since she has a "clear track" all the way, and none of the delays which take up so much of the time of the freight trains, she can make the run from Duluth to Buffalo regularly in 3 days; and it has been made in as short a time even as 56 hours. By rail from Duluth to Buffalo, via the Northern Pacific, Wisconsin Central and Lake Shore & Michigan Southern Rys. is 1,047 miles; hence, a freight train to make the run in 56 hours would have to make nearly 19 miles per hour, *including stops*. Comparing the rail and lake transit in point of expense, the propeller costs about $120 a day to run, or $360 for the trip. Hence, if she has no return cargo whatever, the cost per ton of carrying the grain from Duluth to Buffalo will be only 27 cents. Thus, if the rail lines carried at the same rate as the actual cost of carriage by the water route, they would receive only $\frac{1}{30}$ of a cent per ton mile. Of course, this leaves out of account the cost of the boat in the one case and the cost of the rolling stock and permanent way in the other; thus making the comparison even more favorable to the railway than is actually the case.

That the importance of this great natural highway is fully appreciated, the following official figures of the freight passing through the locks of the Sault Ste. Marie Canal in the seasons of 1888 and 1889 fully show:

	Season of 1888.	Season of 1889.	Increase. Total.	P. c.
No. vessels	7,803	9,579	1,776	23
Net registered tonnage	5,130,659	7,221,935	2,091,276	41
Net tonnage, freight	6,411,423	7,516,022	1,104,599	17
Net tons coal	2,166,041	1,629,197	*475,844	23
Barrels flour	2,190,725	2,228,707	37,892	02
Bushels wheat	18,596,351	16,231,854	*2,364,497	13
Bushels other grain	2,022,308	2,133,245	110,937	05
Net tons iron ore	2,570,517	4,095,855	1,525,338	59

*Decrease.

About 40 per cent. of the tonnage passing through the canal is engaged in Duluth trade. It is expected that the completion of the new lock at the Sault, which will permit the passage of vessels drawing 21 ft. of water, will give a new impetus to Duluth's commerce and make still more certain the supremacy of the water route over the rail route.

The Castlewood Dam, Denver Water Storage Co.

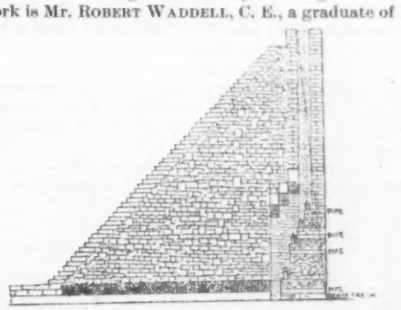
The Denver Water Storage Co., of Denver, Colo., has well under way the construction of a dam, near the head of Cherry Creek, in Douglas Co., Colo. As the late failure of the Walnut Grove Dam has caused some apprehension, the Denver *Daily News* has published a cut and description of this dam, which account is here condensed.

This dam is intended to eventually store nearly 230,000,000 galls. of water; with a drainage area of about 350 sq. miles behind it; an average rainfall of 18 ins. per annum, and a winter flow in Cherry Creek of 10 cu. ft. per second. The storage lake will cover 180 acres, with 70 ft. as the maximum depth near the dam, and an average depth of 30 ft. The overflow from this lake will fill smaller lakes below, and by mean of ditches irrigate about 30,000 acres of land, of which the company owns 16,000 acres.

The original plans for the dam were drawn up by Mr. A. M. WELLES, C. E., the engineer of the company. As designed the dam will have a total length of 635 ft. on top, the ends being imbedded about 15 ft. into the sides of the cañon. At the centre the dam is 65 ft. high, with bottom length at centre of 83 ft. In cross-section the dam has a slope of 1 horizontal in 10 vertical on the water face, and a slope of 1 to 1 on the other or dry face. The dam is built of a hard, non-porous sandstone, and if completed according to the plans will weigh 75,000 tons. It rests upon a bed of pure clay, of a somewhat greenish color, with hard-pan deposits in it in places.

In its construction, the front and back walls are laid in cement for a thickness of 5 ft. each, with the intervening space filled with closely packed rock. As described, the foundation was excavated 15 ft. in the clay, and all "air-holes" filled by liquid grout. The waste-weir is shown in the centre of the dam, on a "progress elevation" given. The cross-section here reproduced from the *Daily News* apparently shows a bottom outlet, imbedded in concrete, communicating with a shaft and valve-chamber and horizontal pipes at different levels. But not enough of the detail is here given to show or describe the overflow and the detail of the dam.

The Resident Engineer directly in charge of the work is Mr. ROBERT WADDELL, C. E., a graduate of



Castlewood Dam, Denver Water Storage Co.

McGill University, and engaged since 1881 in irrigation work in Colorado. He reports on March 6, that about 25 per cent. of the work is completed and that it will probably be finished by June 1. The estimated cost of the ditch and the dam combined is $350,000. The president of the company is CARLISLE N. CREIG; C. H. ROSENFELD is vice-president and WM. E. ALEXANDER is secretary and general manager.

The canal leading from the dam to the lower lakes mentioned is 50 miles long; for the first 10 miles this canal is 21 ft. wide on top, and for the remaining 40 miles 18 ft. wide. The depth throughout is 4 ft., with a fall of 2½ ft. to the mile. The company claims to be using every precaution to insure good work, by the careful inspection of trained engineers. The cement used is said to be Denver and English Portland mixed in equal parts. The water in the catchment lake thus formed will be led to the lakes and canals below as soon as the Castlewood Lake is one-half full.

THE HARLEM RIVER TUNNEL PROJECT was argued before the Committee on General Laws at Albany on March 16. Mr. B. R. GUION, C. E., described the tunnel proposed in the bill introduced by Mr. C. C. CLARKE. It would be located near Third Ave., and as now planned would commence at the south side of 137th St., at the present grade, and the east line of Third Ave.; it would run thence in a southerly direction, on a down grade of 3 ft. 10 ins. per 100 ft., for a distance of 1,400 ft. to the north bulkhead line of the Harlem River. Thence it would pass south under the river, and 42 ft. below mean low tide for 400 ft. to the south bulkhead line; thence south on a line parallel to and 105 ft. east of Third Ave., with an up grade of 3 ft. 10 ins. per 100 ft. for 1,436 ft., to the north

line of 125th St. It is proposed to build it across the river in coffer-dams, one-half at a time. The tunnel would be built of brick, founded on piles, with two arches of 15 ft. span and 7½ ft. rise separated by a brick pier 6 ft. thick. The side walls would be 5 ft. thick and the arches 3 ft. thick, with 4 ft. of concrete covering the arches under the river. The approaches would be of the same general dimensions. The roadway in each arch would be 10 ft. wide with a 5-ft. sidewalk, and the height of the tunnel, from floor to intrados of arch, would be 15ft. The estimated cost is $3,000,000.

THE EAST RIVER TUNNEL PROJECT is now before the New York Councils for permission to commence work; but it has been referred to a committee on tunnels and bridges, which committee does not seem inclined to act upon it at all. Mr. O. W. BARNES, C. E., the engineer of the company, says that all the plans are completed in every detail and that work could be commenced within one week after the necessary authority is secured. This is the project for connecting the Long Island railway lines with the Vanderbilt system and New York City generally by way of Hunter's Point and Forty-second St.

THE COMPLETION OF THE NEW CROTON AQUEDUCT is promised by Commissioner SCOTT by July 1 next. But he admits that it will require "a good deal of hustling" to accomplish this result in the time given. The work on section 9, near Yonkers, and the pipe line from 135th St. to the reservoir in Central Park may cause delay.

---

orrections for Baker's "Masonry Construction."

In addition to the corrections noted below, a few typographical blemishes have been removed. If any one has discovered other errors, the author will be pleased to have notification of the same.

ERRORS IN 1ST EDITION CORRECTED IN 2ND.

Page 193, at foot of page, *insert* S = the span, in feet.
Page 239, 11th line, read "the length of pile *25 ft.*"
Page 239, 12th line, for *lbs.* read *tons.*
Page 239, 13th line, for *lbs.* read *tons.*
Page 246, foot note, for *377* read *273.*
Page 281, 4th line, for *135½ below high water* read *109 ft. 8 in.*
Page 300, 20th line, for *132* read *110.*
Page 300, 29th line, for *132* read *110.*
Page 393, foot note, for *§70* read *§64.*
Page 405, 5th line below table for *middle* read *division wall.*
Page 455, 5th line of §679, for *the abutment* read *any joint.*
Page 462, 8th line below equation (10), for (*S*) read (*o*).
Page 474, foot note, for *445* read *455.*

ERRORS IN 1ST AND 2ND EDITIONS CORRECTED IN 3RD.

Page 485, in five places, for *Fig. 131* read *Fig. 135.*
Page 465, for the first two sentences under eq. (11) substitute the following: *The above relation, due originally to Navier, has in itself nothing to do with the position of the line of resistance, but is employed by writers who assume that an arch is stable if a line of resistance can be drawn anywhere within the middle third of the arch ring, to determine the crown thrust. Notice, however, that under these conditions the radius of curvature is known only within limits.*
Page 490, §708, for paragraph 1 substitute the two following: *This theory is approximate since it makes no attempts to determine the true line of resistance, but finds only a line of resistance which lies within the middle third of the arch ring.*
The radius of curvature to be used in finding the crown thrust is indeterminate. It is frequently, but erroneously, taken as the radius of the intrados at the crown.
Page 491, at the end of §708 the following objection to Rankin's theory has been added: *Rankin himself says (Civil Engineering, p. 422) that the method of §707 is inapplicable to circular arches greater than 90°, and gives a complicated formula for that case.*

CHAMPAIGN, Ill., Jan. 25, 1890. IRA O. BAKER.

PERSONALS.

Mr. GEO. Q. ELY has been appointed Superintendent of Streets at Manchester, Va.

Mr. LEVI HEGE, Superintendent of the main stem division of the Georgia Central R. R., has resigned.

Mr. E. V. R. THAYER has resigned his position as a Director of the New York & New England R. R. Co.

Mr. H. B. BURLEY has been appointed City Engineer of Nashua, N. H., vice Mr. C. E. EMERSON, resigned.

Mr. FRED. M. FAIRCHILD has been appointed City Electrician of Nashville, Tenn., at a salary of $1,300 per annum.

Mr. ALLEN A. CHAPMAN, at one time a director of the Baltimore & Ohio R. R. Co., died March 4 at Baltimore, Md.

Col. J. MERVYN DONAHUE, President of the San Francisco & Northern Pacific R. R., died March 3 at San Francisco, Cal.

Mr. A. F. BANKS has been appointed Traffic Manager of the Central Iowa Ry., with headquarters at Marshalltown, Ia.

Mr. DOREMUS has been appointed City Surveyor of Salt Lake City for the unexpired term of Mr. JESSE W. FOX, Jr., resigned.

Mr. GEO. L. WILSON has been reappointed Assistant City Engineer of St. Paul, Minn., under Mr. RUNDLETT, City Engineer.

Mr. MILLARD HUNSIKER, of Pittsburg, Pa., has resigned his position as Assistant Secretary and General Agent of the Carbon Iron Co. of that city.

Mr. ARTHUR E. HILL, C. E., has been appointed engineer of the water-works to be constructed at Westminster, B. C., at a salary of $2,000 per annum.

Mr. JOHN M. DAVIDSON, for several years President of the Saratoga & Whitehall R. R. (now a part of the Delaware & Hudson system), died at Saratoga, N. Y., March 7.

Mr. J. T. FANNING, C. E., of Minneapolis, Minn., will report upon the plans and specifications now under consideration by the Water Commissioners of New Westminster, B. C.

Mr. ARTHUR CRANDALL, representative of the Dunham Mfg. Co. in Chicago and the Northwest, has taken the position of Secretary of the company, with headquarters at the Chicago office, Phenix Building.

MR. W. C. AMES has accepted the position of Locating Engineer of the Michoacan & Pacific R. R., with headquarters at Maravatio, Mexico. His transitman is GEO. H. AMES; Topographer, C. L. KELLEY; Leveler, H. M. ROOT.

Mr. C. M. BENNETT has been appointed Superintendent of the Western Division of the Chicago, St. Louis & Pittsburg R. R., vice Mr. CHARLES WATTS, promoted. Mr. F. G. DARLINGTON has been appointed Superintendent of the Eastern Division, vice Mr. BENNETT, transferred.

Mr. JOHN A. CARTER died at Rockville, Md., March 10. He was for a long time employed in the engineering department in the construction of the tunnel of the Baltimore & Potomac R. R. at Baltimore. He was a brother of Col. H. C. CARTER, General Superintendent of the southern division of that road.

The Union Switch & Signal Co., of Pittsburg, Pa., has made some changes in its staff. The list of officers is now as follows: President, GEO. WESTINGHOUSE, Jr.; Vice-President, C. H. JACKSON; Treasurer, R. PITCAIRN; Secretary, A. T. ROWAND; General Manager, E. H. GOODMAN; Assistant General Manager and General Agent, R. H. SOULE; Superintendent, J. T. HAMBAY; Auditor and Assistant Secretary, JAS. JOHNSON. The Boston office has been removed to the Hathaway Building.

Mr. HENRY WOOD, Bridge Inspector on the Eastern Ontario division of the Canadian Pacific Ry., died at Ottawa, Ont., recently. Mr. WOOD was born in Littleboro, Lancashire, England, in 1823, and came to this country in 1854, being sent from England by the contractors to superintend the construction of the bridges on the lower section of the Grand Trunk Ry. For the last 15 years he was in the employ of the Canadian Pacific Ry. and for the last 8 years he held his late position, with headquarters in Ottawa.

Mr. THOMAS TAIT has been appointed General Superintendent of the Ontario and Atlantic divisions of the Canadian Pacific Ry. The two eastern divisions are to be consolidated, and Mr. TAIT will manage from headquarters at Toronto the division that was formerly under Mr. MACKINNON'S superintendence at Montreal. The Ontario division has extended from Smith's Falls westward, and the Atlantic from that point to the east. Mr. TAIT will now exercise supervision from Port Arthur on the north and Windsor on the west to the borders of New Brunswick on the east.

THE following appointments have been made on the Ontario and Atlantic Divisions of the Canadian Pacific Ry.: Mr J. W. LEONARD, Superintendent of the Atlantic Division, with office at Montreal. Mr. T. WILLIAMS, Assistant Superintendent, Toronto Junction to Windsor and Guelph and Ingersoll branches. Office at Toronto. Mr. R. R. JAMIESON, Assistant Superintendent, Toronto to Owen Sound (including Toronto Junction, Parkdale and Queen's Wharf), Teeswater, Orangeville and Elora branches. Office at Toronto. Mr. R. CARDIFF, Assistant Superintendent, Toronto Junction to Montreal Jct. and St. Luc Jct. Office at Smith's Falls.

PUBLICATIONS RECEIVED.

—*Thirty-first Annual Report of the Railroad Commissioners of the State of Maine.*—For the year ending Sept. 30, 1889. D. N. MORTLAND, A. W. WILDES, ROSCOE L. BOWERS, Commissioners. 6x9 ins., cloth bound, 302 pp.

The report includes, in addition to the usual statistical tables compiled from the annual returns of the railway companies of the State, the various decisions rendered by the board during the year.

—*Twenty-third Annual Report of the City Engineer (of Boston) for the year* 1889. Pamphlet, 126 pp. WM. JACKSON, City Engineer.

This report reviews the work done under the City Engineer's Department, proper, and also in connection with the Water-Works, Improved, Sewerage, or Main Drainage and Parks. The illustrations given are: details of Leyden St. Bridge, 35 ft. span; placing of 30-in. siphon at Warren Bridge, in connection with water-works; sections showing lining of portions of Beacon St. water-works tunnel and three views of work in progress. There is also a diagram showing the rainfall and daily and yearly average consumption of water for the years 1875 to 1889, inclusive, and a second diagram showing the heights of Sudbury River reservoirs, Farm pond, and Cochituate and Mystic lakes and the rainfall on the Sudbury River water shed during the year 1889. The diagrams are supplemented by tables giving further statistics.

An appendix contains an alphabetically arranged table of contents of City Engineer's Reports published from 1868 to 1889, inclusive. The value of this will be apparent to all.

—*Fifth Annual Report of the Board of Sewer Commissioners of the City of Pawtucket for the Year Ending Nov.* 30, 1889. Pamphlet, 15 pp. A. R. SWEET, Engineer and Superintendent.

The total length of sewers is 13.12 miles, of which 10.56 miles are of salt-glazed pipe, 2.43 miles of brick, 1,289 ft. of cement pipe, for overflow, and 397 ft. of iron pipe. The total number of connections is 604, providing for the drainage of 684 buildings.

—*Report of the Operations of the Engineer Department of the District of Columbia, under the direction of Maj. Chas. W. Raymond, Corps of Engineers, U. S. A., Engineer Commissioner, District of Columbia, for the Fiscal Year* 1888-9. Pamphlet, 345 pp.

This report contains three large and one small map. The first map shows the area of the city covered with water during the flood of June 1, 2 and 3, 1889. The second map accompanies the report of Capt. JAS. L. LUSK, and shows in detail the distribution system of the water-works. The third also accompanies Capt. LUSK'S report, and shows the location and size of sewers. The small map shows the progress of the topographical survey of the district, to June 30, 1889.

Of the many valuable features of this report our space permits us to mention only the cement tests, the questionable and condemned wells and summary of houses supplied with Potomac water, by street frontages and number of stories.

—*Proceedings and Addresses at a Sanitary Convention held at Pontiac, Mich., Oct* 17 *and* 18, 1889. Pamphlet, 119 pp. Do., at Vicksburg, Mich., Dec. 5 and 6, 1889. Pamphlet, 73 pp.

These publications contain, in addition to other matter, papers on the water supply and sewerage systems of Pontiac and Vicksburg, Mich. A noteworthy paper is one entitled "The Climate of Michigan, with more Especial Reference to the Rainfall and Temperature," by Sergt. N. B. CONGER, Director of the Michigan State Weather Service. This paper is accompanied by 26 precipitation charts of the State, showing precipitation for each month in 1888, the normal precipitation for each month for 13 years, the precipitation for 1888 and the normal yearly precipitation for 13 years.

—*Sixth Annual Report of the Board of Water Commissioners to the City of Northampton, Mass., for the Year Ending Nov.* 30, 1889. Pamphlet, 17 pp. J. N. CLARK, Superintendent.

Northampton is one of the comparatively few cities, of those having public ownership of water-works, that pay the water department a definite yearly sum for fire protection and other public uses of water. The plan has been in vogue since 1874.

—*City of Springfield. Twenty-first Annual Report of the Superintendent of Streets and Sewers, for the Year* 1889. Pamphlet, 44 pp. W. L. DICKINSON, Superintendent.

"Sewer Statistics," at the end of the report gives the length, size, material and cost of each sewer constructed up to Dec. 10, 1889. The total length is 50.85 miles. Total cost, $619,890.

—*Railway Engineer's Field-Book and Explorers' Guide.*—Especially adapted to the use of Railway Engineers on location and construction, and to the needs of the explorer in making exploratory surveys. By H. C. GODWIN, New York. John Wiley & Sons, 12mo., tucks, pp. 358, 108 pages of tables, 100 cuts. $2.50.

The more novel part of this work, and the only part which on cursory inspection seems to have much that is especially novel about it, is that on exploratory and astronomical work, this is fuller than in any other pocket-book which we recall. The part relating to construction, however, is also quite full, and altogether it seems likely to be a convenient book for the young engineer to have. We shall review the work more fully later.

—*Foreign Commerce and Navigation, Immigration and Tonnage of the United States* for year ending June

30, 1889. Pub. Doc. Bureau of Statistics. 8 vo., pp. 1,002.

A compendium of the most detailed information on its subject matter, extending back over several decades. It shows a sad state of our ocean marine, growing no better and a notable tendency to deterioration in the average quality of emigrants.

—*Report of Board of Mediation and Arbitration* of State of New York. N. Y. Pub. Doc. 8vo., pp. 437 and 188.

A wretchedly sloppy report, not even containing a summary of the hundred or two strikes described in detail. The Board claim that its work is doing good, and we trust it is, but if they are no more systematic in their investigations than they are in their reports, their work can be of little use.

—*Multiplication and Division Table* for all numbers up to 100 x 100. By CHAS. H. GILLETT. Appleton, Misc., 1 large sheet, 12 x 15 ins.; 25c.

Many readers, no doubt, will find this table a useful office companion if mounted on a sheet of card-board. It can be obtained from the author or from this journal.

—*The Danger and Wrong of Existing Legislation Concerning Railways; A Review of Its Results.* Pamphlet, 36 pp. Railway Age Publishing Co., Chicago, Ill.

This pamphlet is a reprint of the Directors' report of the Chicago & Alton R. R. Co. The gist of the report has already been given and editorially discussed in our columns.

TRADE PUBLICATIONS.

—*The Baker Heater.*—Illustrated pamphlet of the Baker system of heating railway cars by hot water. 16 pp. Baker, Smith & Co. New York and Chicago.

SOCIETY PROCEEDINGS.

The American Society of Civil Engineers.—Meeting of March 19; Vice-President A. Fteley presiding, with about 45 members present. Mr. Charles E. Emery continued his description of the details of construction of the plant of the New York Steam Co., commenced at the last meeting. A discussion by a number of the members present followed.

Engineering Association of the Southwest.—At the meeting at Nashville, Tenn., on March 13, a paper was read by Mr. C. A. Locke, U. S. Assistant Engineer, Nashville, Tenn., entitled "Memorandum of Government Survey in 1889 of the Cumberland River below Nashville;" and a paper by Mr. Geo. Reyer, Superintendent of Water Works, Nashville, Tenn., on "The Recent Duty Test of the Holly-Gaskill Pumping Engine at the New Pumping Station, Nashville, Tenn." Secretary, Olin Landreth.

Engineering Society of the School of Practical Science, Toronto.—At a recent meeting Mr. T. S. Russell read a paper on railway construction and surveying, illustrating the paper with photographs and profiles of the work carried on by him in Manitoba last summer. The writer described the new machine for excavating and embanking earth, a machine, which, though it does its work very quickly, is said to be open to serious objection on account of the loose manner in which it throws up the dirt. Other details, especially an ingenious method of determining the dump in earthwork, were also described.

Civil Engineers' Club of Cleveland, O.—The annual meeting was held March 11, President W. R. Warner in the chair.

Reports were presented on the progress in engineering for the year by the chairmen of the different committees, as follows: On Civil Engineering and Surveying, C. G. Force, Jr.; on Railroad Engineering, A. Mordecai; on Architecture, J. N. Richardson; also on Mechanical Engineering, read for the chairman of that committee by Mr. Walter Miller.

The President presented the annual report of the Executive Board, accompanied by the annual reports of the Treasurer, S. J. Baker, and of the Secretary. C. O. Palmer.

The ballot for officers for the ensuing year resulted as follows: President, W. H. Searles; Vice-President, J. L. Gobeille; Secretary, C. O. Palmer; Corresponding Secretary, S. J. Baker; Treasurer, N. P. Bowler; Librarian, C. N. Barber; Member of the Board of Managers of the Association of Engineering Societies, Prof. Cady Staley.

Northwestern Railroad Club.—The meeting of March 8 was on "Brasses." The paper read was by G. L. Warren, giving the following record of experiments in coefficients of friction, lubricated and unlubricated. We do not consider these tests as entirely reliable. The experiments were made with two materials for journals—one, Norway iron and the other machinery steel. The bearings, four in number, we will class for convenience as *A*, *B*, *C*, and *D*. *A* was composed of 6 parts by weight of copper and 1 of tin. *B* was composed of 8 parts copper, 1 tin. *C* was composed of 1 part copper, 2 antimony, and 24 tin. Each of these mixtures was refined. *D* was composed of 8 parts lead, and 1 of antimony. The pressures per square inch were 100 lbs., 200 lbs., and 300 lbs., respectively.

	Steel oiled.	Iron oiled.	Steel dry.	Iron dry
At 100 Lbs.				
A	.00445	.00447	.0147	.0109
B	.00350	.00467	.0109	.0131
C	.00406	.00390	.0108	.0175
D	.00367	.00350	.0092	.0169
At 200 Lbs.				
A	.00437	.00581	0130	.0131
B	.00399	.00582	.0133	.0142
C	.00436	.00437	.0136	.0153
D	.00381	.00456	.0131	.0175
At 300 Lbs.				
A	.00473	.00574	.1330	.1150
B	.00400	.00629	.1340	.1200
C	.00381	.00409	.1300	.1870
D	.00345	.00500	.1420	.1620

The coefficient given by Morin for brass upon wrought iron is .054, while those used for the friction on ordinary cars are from 6¼ to 11½ lbs. per ton. Experiments by PENN showed that brass upon iron abraded at 675 lbs. per sq. in. pressure, while at 975 lbs. per sq. in., it sat fast, and babbitt metal rolled out at 1,600 lbs. per sq. in.

The Engineering Association of the Southwest.—The regular monthly meeting of the Association was held at Nashville, Tenn., on March 13, President John MacLeod, of Louisville, Ky., presiding, with about thirty in attendance. A communication was received from the *Tradesman*, of Chattanooga, Tenn., offering a cash prize of $25 for the most meritorious paper read before the Association by any member thereof, between the meetings of December, 1889, and June, 1890, inclusive, the award of the prize to be made by the Executive Committee of the Association. The proposition was accepted by the Association. The programme of the evening comprised a paper by Mr. C. A. Locke, U. S. Asst. Engineer, Nashville, Tenn., on "The government survey of the Cumberland River below Nashville conducted in 1889." The paper contained an account of the regimen of the river, and the results of the examination for suitable sites for locks and dams, with estimates of cost of the construction of the same, and an exhibit of the probable results of the improvement in the navigation of the river. In the discussion Mr. Joseph W. Walker, United States Assistant Engineer in Charge of Lock and Dam No. 1, submitted drawings and a description of the form of moveable dam which is under consideration for adoption on this river. The dam is of the "American Bear-Trap" type, stiffened by torsion bars. The decision as to the style of dam to be adopted rests with a board of United States engineers, who will make their report in the spring. Borings near the mouth of the Cumberland on the survey, developed at one point specimens of a peculiar, indigo-blue mineral resembling in form fragments of roots of trees occurring in a stiff drab clay and about 6 ft. below low water. Dr. William L. Dudley, of Vanderbilt University, submitted an analysis of the mineral, which he stated to be a very novel and peculiar one, composed of the phosphates of iron and aluminum resembling "Vivianite." Its form was doubtless due to its having replaced the decaying woody matter in the submerged roots of trees. Prof. P. W. Clarke, of the U. S. Geological Survey pronounced the mineral a very interesting and peculiar one, and requested that the results of further examinations and specimens of the mineral be sent to the National Museum at Washington. The paper announced for the evening by Mr. Geo. Reyer, Superintendent of Nashville Water-Works on "The Recent Duty Test of the Holly-Gaskill Pumping Engines of the Nashville Water-Works" was read by title only, as the results of the test had not been fully reduced. The paper will probably be published by the Association as soon as completed. The programme of the next meeting of April 11, which will be devoted largely to the subject of securing heavy submerged bridge foundations, will include a paper on "The Foundations of the Louisville & Jeffersonville Bridge," by Mr. Robert D. Engle, engineer in charge of this bridge, the foundations of which are now being built by Sooysmith & Co.; also a paper on "Dredging Under Pneumatic Pressure," by Mr. Charles Hermany, Chief Engineer of the Louisville Water Co., who recently constructed, for the extension of the Louisville water system, one of the largest pneumatic caissons ever built.

New England Railroad Club.—The annual meeting was held Wednesday, March 12, President Richards in the chair. The report of the Secretary and Treasurer showed that the club has 194 members, that the attendance at the meetings during the year was 523, an average of 58 per meeting; 6 members have resigned and 3 have died. The receipts for the past year amounted to $578.18; expenses, $460.12; balance in the treasury, $118.06.

Mr. JOHN KENT, of the Nominating Committee, reported a list of officers for the ensuing year, who were duly elected as follows: President, Geo. Richards; Vice-President, Orlando Stewart; Secretary and Treasurer, F. M Curtis; Executive Committees, Geo. Richards, ex officio, F. D. Adams, J. N. Lauder, Albert Griggs, J. W. Marden, L. M. Butler, F. M. Twombly, John Coghlan; Finance Committee, Geo. Richards, ex officio, Chas. Richardson, Isaac N. Keith, Daniel S. Page, A. G Barber, Osgood Bradley, Joel Hills, Geo. H. Wightman

The subject for discussion at the next meeting was announced as "Locomotive Boilers," and for the present occasion, "Freight Car Couplers."

The Secretary then read a circular, which had been issued by the Executive Committee of the club and sent to the managers and superintendents of the various railroads in New England, for the purpose of obtaining the opinions of the men who use the different couplings as to which is the best and safest. The inquiry was as to the form of coupler which best combines uniformity, automatic action and safety.

One thousand nine hundred and forty-eight votes were received in response to the above circular, distributed as follows: In favor of the Safford coupler, 1,239; Janney, 557; old fashioned link and pin, 63; Boston automatic, 30; Gould, 26; Miller, 25; Marks, 5; Dowling, 2; Cowell, 1.

Mr. F. D. ADAMS: A few years ago the Ames coupler was adopted and used quite extensively; several thousand cars of the Boston & Albany and the Vanderbilt road were equipped with it. Through the misfortune of its manufacturer it did not prove to be as successful as was anticipated, but I believe it is one of the best couplers ever made: it is, however, being entirely abandoned. We have used the Safford for a great many years, and we have watched the success of the Janney type, or what is termed the Master Car Builders' type, with much interest. Mr. Adams went on to express his preference for the Safford or plain link draw-bar, and his condemnation of the M. C. B. type, he having long held to this position.

Mr. MARDEN had not been a believer in the Master Car Builders' type of coupler. He did not believe that any material that can be had cheaply enough to make the knuckles of is strong enough to bear the shocks it receives. He had had 100 cars equipped with it, and they have been out of service more than half the time on account of being disabled by broken draw-bars, and when we add to that the expense of repairing and of taking them to the shop, it has proved rather a costly experiment. They were equipping cars now building and repairing with what is known as the Perry coupler, an automatic coupler which they had used for several years.

Mr. SHINN: Three years ago I had occasion to make some tests of couplers, and I found that a blow of about one-third of the number of foot pounds required to break a malleable iron or cast-steel knuckle would put a permanent set in the knuckle, and render it useless if two of the same kind came together. If they sometimes receive a blow sufficient to cause a fracture, they must much oftener receive the lighter blow which will cause the permanent set, sufficient in many cases to prevent the coupling of the cars when two of this kind come together. In investigating this subject before I made the tests, I visited a number of railroads in the country where tests were made of vertical plane couplers, and among others the C., B & Q, where I found the scrap pile told a wonderful story regarding these couplers; I found there were knuckles made of all descriptions of metal, including malleable iron, cast steel of the best make and some others, and they all had broken under conditions to which they were exposed, and my conclusion was that that occurred either through a fault in the form, want of sufficient metal or want of strength in the metal itself, and railroads could not afford to be equipped with that sort of coupler unless better material would be found. I think the day will come when a better metal will be had than is now being used for that purpose, and I think then the danger of permanent set will disappear and the percentage of breakage will decrease.

Mr. GETHAN: With regard to the use of the vertical hook, I will say that where cars have been kept together and equipped with this coupler, the number of breakages has been very much less than with those where they have been mixed up with cars equipped with all sorts of couplers.

Mr. LAUDER: Assuming that the statistics that we get from different quarters are approximately correct, it seems that there is a vast difference between the breakages reported by different roads, and I think it is plain how that difference comes about. The roads that have taken hold of the vertical plane coupler, or more properly the Janney type of coupler, and equipped any considerable number of cars with it, as a rule will be found to have put this coupler on to a special class of cars, as stock cars, fruit cars, etc., where the trains are made up, perhaps, with the products of the West, beyond the Mississippi or Missouri River, and run to New York or Boston without really being uncoupled. Uunder those circumstances, the breakages of any coupler, especially a hook coupler, would be very slight.

Mr. COUGHLAN: The trouble with the hook coupler is the defect in its mechanical construction, and no piece of mechanism constructed in that way could endure one-quarter of the shocks to which a freight car is subjected, carelessly handled as it often is in the yard by trainmen. It does not matter of what metal it is made, but if made in this form it will bend, and if it does not bend it will break, and as soon as it is bent its efficiency is lost.

A long paper upon couplers, prepared by JOHN H. FORD, was read by Mr. ADAMS. He also had a low opinion of the M. C. B. type. We comment on this meeting editorially.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXIII. Saturday, March 22, 1890.

D. McN. STAUFFER A. M. WELLINGTON
EDITORS.
CHAS. W. BAKER E. E. R. TRATMAN M. N. BAKER
ASSOCIATE EDITORS.
GEO. H. FROST.....BUSINESS MANAGER

SUBSCRIPTIONS.

To United States, Canada, and Mexico.

One Year, **$5.00;** *6 months,* **$2.50;** *3 months,* **$1.50;** *Single Copies, 12 cents. To all* **Foreign Countries** *of the Postal Union, add $2.08 to above prices for postage.*

CLUB RATES.

Two new subscriptions	$9.00
One renewal and one new subscription	9.00
Five new subscriptions	20.00
One renewal and four new subscriptions	20.00

Subscribers *can have the mailing address of their paper changed as often as they desire. Send both the old and the new addresses.*

The date *when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance.* **No other receipt** *is sent unless requested.*

Advertising rates. 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we will be obliged if parties who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Western Society of Engineers, Chicago, Ill.—Next meeting, April 2. Secy., J. W. Weston, 230 La Salle St.

Engineers' Club of St. Louis, Mo.—Next meeting, April 2. "The Smoke Problem." Wm. B. Potter. Secy., W. H. Bryan, 309 So. 7th St.

American Society of Civil Engineers, New York.—Next meeting, April 2. Secy., John Bogart, 127 E. 23d St.

Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.—Next meeting, April 3. Secy., Clement March.

Engineers' Club of Philadelphia, Pa.—Next meeting April 5. Secy., Howard Murphy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Next meeting, April 7. "Bridge Foundations in the Kansas River," E. I. Farnsworth. Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, April 7. Secy., Geo. L. Wilson, City Hall.

Civil Engineers' Club, Cleveland, O.—Next meeting, April 8. Secy., C. O. Palmer, 22 Cedar Ave.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, April 9. Secy., J. C. Herring, Wichita.

New England Railway Club, Boston Mass.—Next meeting, April 9. Secy., F. M. Curtis, Old Colony R. R. Rooms in the United States Hotel.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, April 10. Secy., Olin H. Landreth, Vanderbilt University.

Western Railway Club, Chicago, Ill.—Next meeting, April 15. Rooms in the Phœnix Building. Secy., W. D. Crosman.

Engineers' Society of Western Pennsylvania.—Next meeting, April 15. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, April 16. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, April 17. Rooms, at 113 Liberty St.

American Water-Works Association.—Tenth annual meeting at Chicago, Ill., May 20. Secy., J. M. Diven, Elmira, N. Y.

Master Car-Builders' Association.—Annual convention at Hygeia Hotel, Fortress Monroe, Va., June 10. Sec., J. W. Cloud, Buffalo, N. Y.

American Railway Master Mechanics' Association.—Annual convention at Chattanooga, Tenn., in June. Sec., Angus Sinclair, 140 Nassau St., New York.

ONE of the surest indications of comparative advance in wealth is the amount of life insurance demanded by a nation. A recent circular of the Equitable Life Insurance Company, which we chanced to pick up lately, shows some curious figures in this respect. It gives in detail the main financial statistics for the six leading companies of the United States, of which it is clearly first, for the 14 companies older than itself, for the 25 companies younger than itself, and for the leading foreign countries. These figures give the following striking comparison:

INSURANCE STATUS JAN., 1889, IN THOUSANDS OF DOLLARS.
(000's omitted.)

Company.	Ins. outstanding.	New ins 1888.
Equitable	549,216	153,934
Mutual	482,125	103,214
New York	419,887	125,620
Northwestern	172,519	43,548
Mutual Benefit	153,499	18,911
Conn. Mutuals	151,362	7,923
Total 6 Cos.	1,928,608	452,550
" 14 older Co.'s	501,819	98,885
" 25 younger Co.'s	358,057	160,000*
Total U. S. 45 Co.'s	2,788,484	711,435

While these totals are not quite complete for Europe, the total is not probably more than $100,000,000 of new business, showing that the present volume of new life insurance taken in the United States is nearly double what is taken out in all Europe.

The total amount of insurance we have not the figures for, but in 1880 the United States had 1,560 millions of insurance in force against 2,110 millions in Great Britain. At the present time Great Britain has somewhat less insurance in force than the United States, but the next decade, if the above figures indicate tendency, will see all Europe together with less life insurance in force than the United States. In 1880 all Europe had 3,465 millions in force.

*Estimated. The statement fails to give it probably because the aggregate showed a slight excess of the Equitable total.

Largest British co	18,737
40 largest British co.'s	130,662
Largest French co.'s	12,000
18 largest French co.'s	81,148
18 Austro-Hungarian co.'s	41,142
34 German co.'s	86,477
Total for England, France, Germany and Austro-Hungary	339,429

A PERSONAL letter from Mr. ROBERT B. STANTON, Chief Engineer of the Denver, Colorado Canon & Pacific Railway, dated Peach Springs, Ariz., March 8, 1890, gives very gratifying evidence of the complete success of that bold exploratory survey in the following words:

You doubtless have seen by telegraphic reports our arrival at Diamond Creek, nearly through the Grand Cañon. But 53 miles more remain to be explored, and that comparatively safe and easy work in all probability.

The results of my explorations have so far been far ahead of my most sanguine expectations. I am sorry that I cannot at this time write you more; I have given somewhat fuller data to the Associated Press.

I promise you good views and description of the *real* Grand Cañon, which is quite different from what some have imagined. We start down to complete our trip as far as The Needles on Monday, March 10.

My kind regards to all inquiring friends. I have gained 14 pounds, so far, on the trip.

The fuller details to which Mr. STANTON referred were abstracted in part last week, but in general show that there is a natural bench 20 to 150 ft. above high-water mark along the whole line, on which a railway can be located with "not half the heavy work which has been done in the mountains of Colorado." That something like this should be true, to the extent that the route must be far more practicable in detail than any layman would imagine under the spell of its awful grandeur, we have already stated to be almost a necessary result of the very magnitude of the stream and gorge. Speaking in the large ouly, it is highly improbable that there should be much more difficulty in running a 5-ft. gauge railway with 10° curves down such a cañon than there would be in running a 1-ft. gauge railway with 50° curves down a cañon of one-fifth the size and one-tenth or less the depth. What the financial status of the present company may be we are not informed, nor have we a particle of interest other than a purely professional one in the project or projectors; but we will give this hint gratis to any and every Western system which has a lurking longing to get to the Pacific by an independent first-class line, that this cañon affords a chance for one far more favorable than any existing line which is never likely to recur, and which they will be very foolish not to look into carefully.

THE verdict of the coroner's jury on the Bay View collision of March 6 is one displaying unusual intelligence and grasp of the situation, and in its essential parts is as follows:

Said train consisted of eleven cars, which broke in two, the forward end stopping and the rear five cars crashing into it. After a careful, earnest and thorough investigation we find that the company should be charged with gross negligence, for the reason that the rules and regulations for the running of their trains are not strictly enforced, and that the safety of passengers is endangered thereby that passenger trains of such length should not be run upon this or any other railroad with only two trainmen—and this jury has reason to believe that the division superintendent has knowledge that passenger trains have been run on said road in an unsafe and crippled condition, and if he had exacted a rigid enforcement of their rules and regulations this accident could not have happened.

The conductor is personally responsible for the accident for these reasons:

1. For leaving Dunkirk with the air brakes on the rear five cars crippled, when it was within his power to make the proper connections of air brakes with but a few moments' delay.

2. For not having the safety chains properly adjusted between the rear day coach and the sleeper "Salina," after the break at Dunkirk.

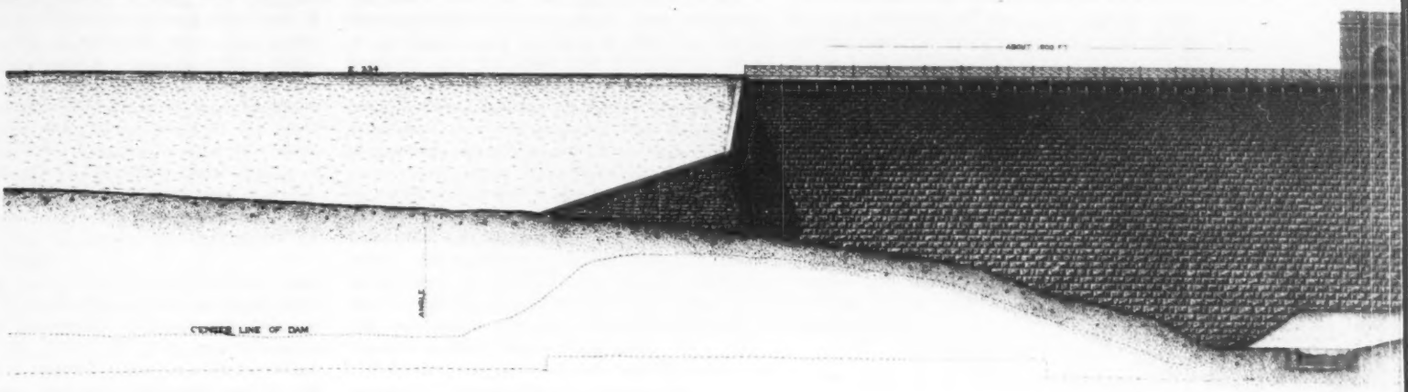
3. For not properly placing his trainmen upon the cars, when the train had parted at Dunkirk, to protect his train in case of a second parting.

4. That at the time of his notification and his own knowledge that the train had parted, at or near West Hamburg, and for a second time, and, in direct violation of the rules and regulations of the company, he pulled the bell-cord with the intention of stopping the forward portion of the train.

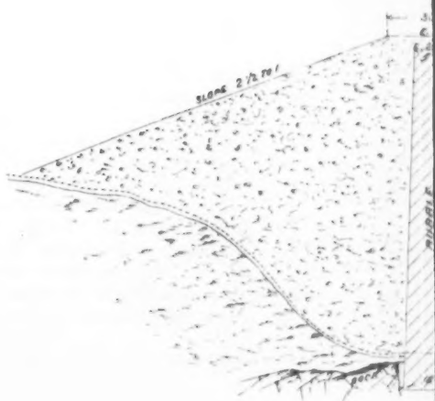
The verdict also censures the head brakeman, not unreasonably, for himself leaving the train without warning the passengers of danger, and professes ignorance of who set the air brakes. The verdict precisely corresponds with our own comments of last week on the disaster, and we think very justly implies that only when there was a certain looseness of system would a conductor venture to handle a train as this was handled, and the remaining employés permit it to be done without protest. In fact, testimony was introduced showing prior instances of running trains with the brakes in a like crippled condition.

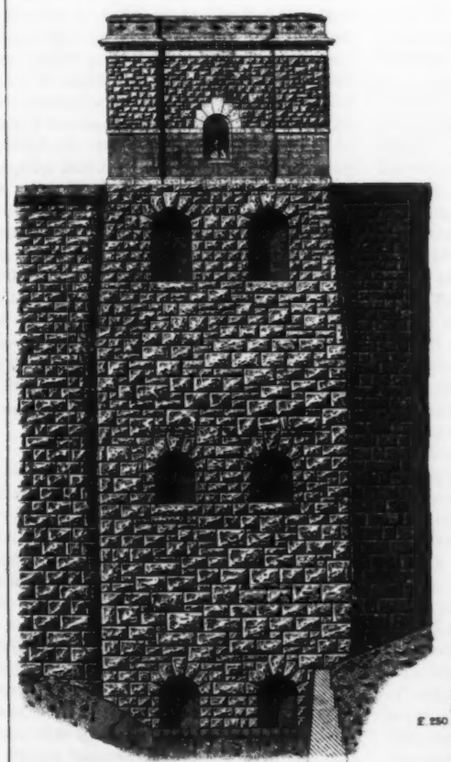
THE report of the last meeting of the New England Railroad Club, given in much condensed form in another column, is somewhat funny reading when studied in connection with the map of the introduction of automatic freight train brakes and couplers, which appeared in our issue of Dec. 21 last. By referring back to that map the reader will see that that section has been decidedly conspicuous for inaction in regard to both of these great betterments. The New York & New England alone of all the New England roads has done enough experimenting with M. C. B. couplers to have it appear on the map, and that only of the mild "dotted" type, so that the whole of New England is practically a blank, while south and west of them, and even north of them, in New Brunswick, the solid red lines indicating an active rate of introduction almost cover the map. This backwardness, as compared with the activity elsewhere, is so conspicuous as to instantly catch the eye of the most careless observer.

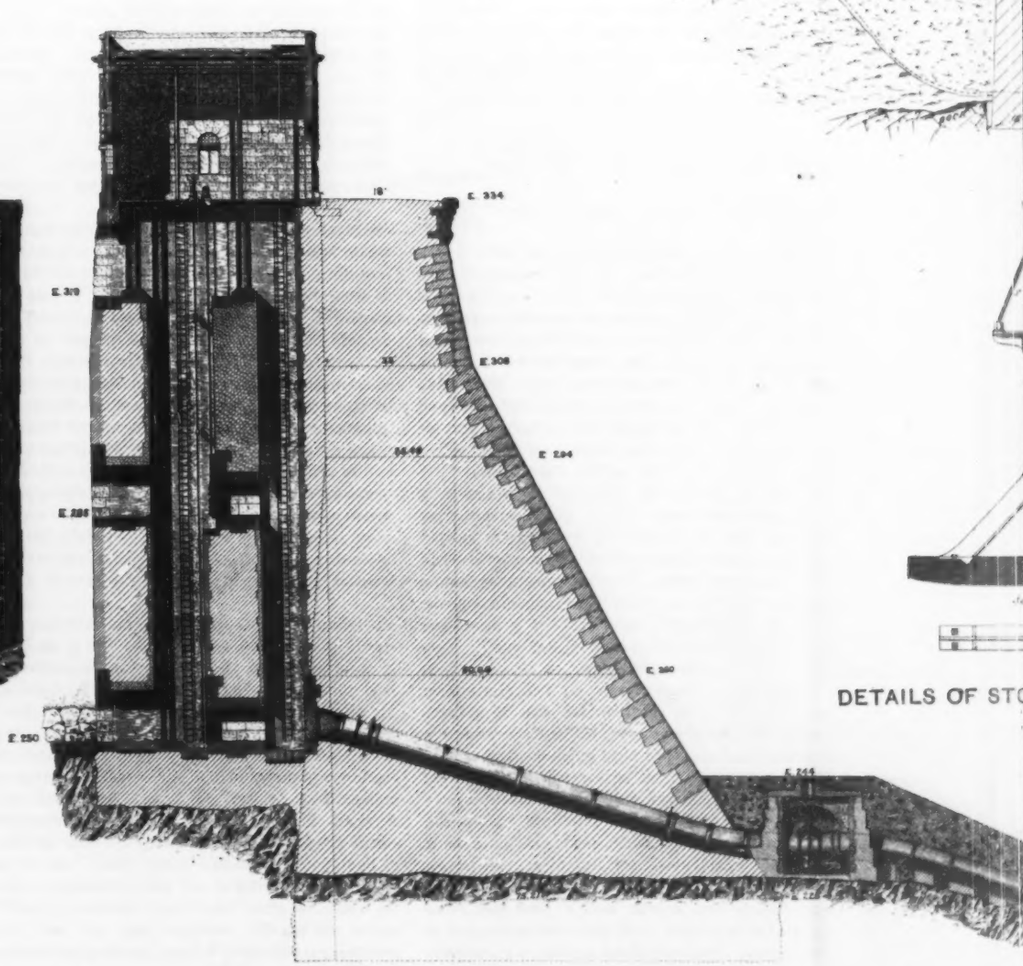
In train brakes they make a somewhat better showing, yet still a very poor one. The Old Colony and the Hoosac Tunnel line have been doing quite a little, and the New York & New England and two or three other short lines something, so as to redeem the section somewhat from the reproach



ELEVATION OF MASONRY DAM



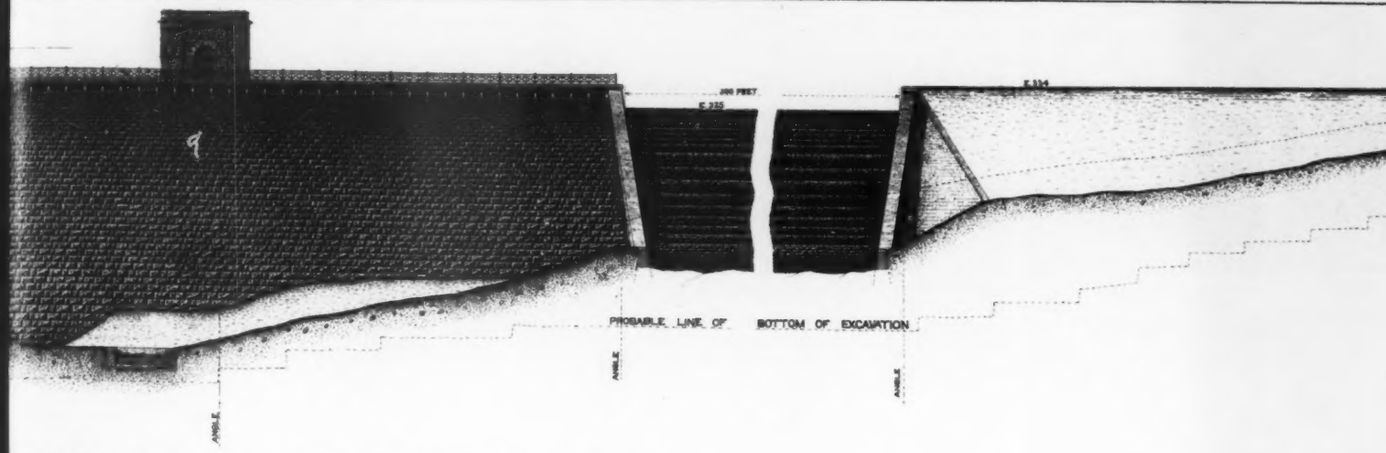




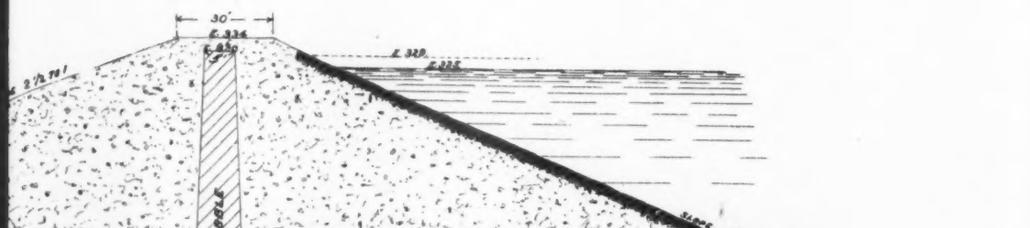
DETAILS OF STO

ELEVATION OF GATE HOUSE.

SECTION OF GATE HOUSE, MASONRY DAM, VAULT AND FOUNT

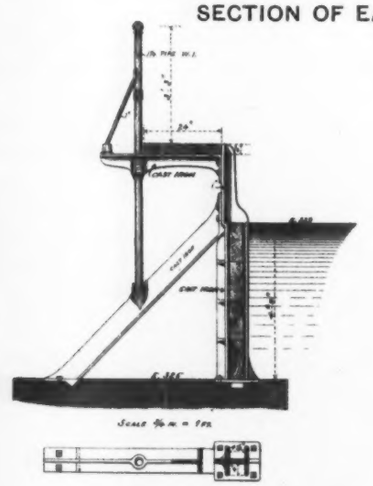


OF MASONRY DAM AND PART OF EARTH EMBANKMENT.

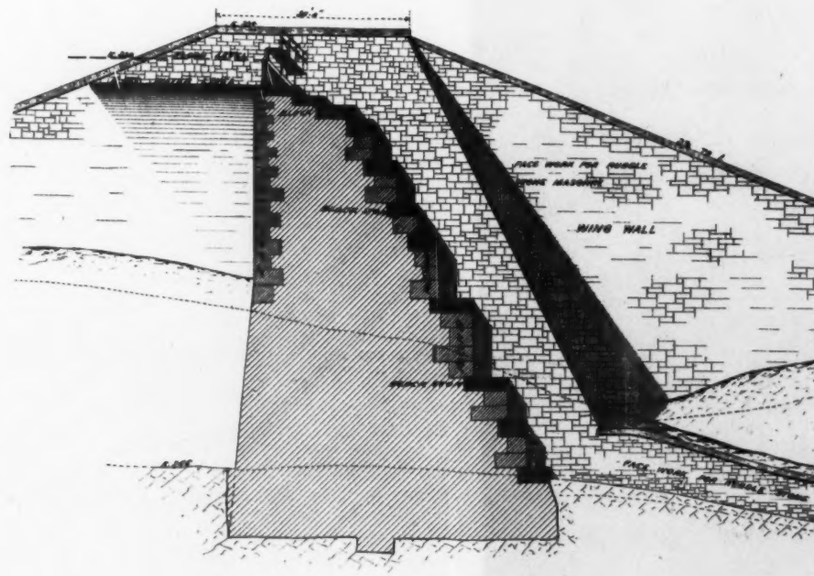


SECTION OF EARTH EMBANKMENT.

DAM FOR R
NEW YORK CITY
ON TITICUS RIVER,
WESTCHESTER C
A. FTELEY,

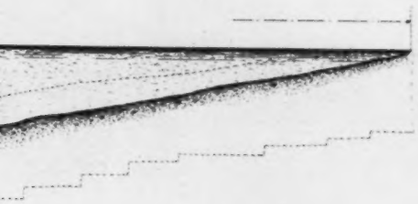


DETAILS OF STOP PLANKS AND FOOTWAY.

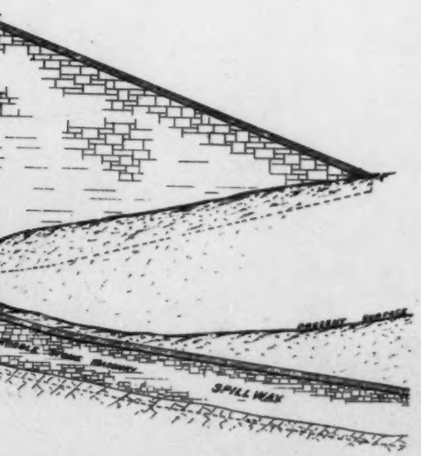


ULT AND FOUNTAIN.

SECTION OF OVERFALL.



TOR RESERVOIR 'M,'
K CITY WATER SUPPLY.
RIVER, NEAR PURDY'S STATION,
ESTER COUNTY, NEW YORK.
A. FTELEY, CHIEF ENGINEER.



CHAS. HART & SONS, LITH., 98 VESEY ST., N.Y.

of total inaction, yet even in this, New England is tagging along in the rear of every other part of the country, even of the South, where thin traffic and slow trains would in a measure excuse delay. It will also be in the immediate recollection of most of our readers that the New England States were very exceptionally backward in the introduction of the Miller passenger coupler, the Westinghouse passenger brake, the modern system of train dispatching, etc., until a succession of terrible disasters finally compelled their use, long after they were in general use throughout the rest of the country.

This being so, one would expect that at a meeting of New England railroad men, no one of whom had had any considerable personal experience in the actual use of the M. C. B. type of coupler, there would at least have been some backwardness in condemning what they had hardly used at all, but what all the rest of the country was using and liking, and calling for more. But no hesitation of this kind was in fact observable. Not a good word was said for the M. C. B. coupler; all was condemnation; and all admitted to be on an extremely thin basis of personal experience. One man had had the great aggregate of 100 couplers in use, had found the breakages to be alarming, and was emphatic in condemnation. It appeared to be nothing to him that the service record of 67,643 couplers on 19 different roads, being all they have in service, is totally different from his experience, as shown in detail in our issue of Feb. 15. His own 100 couplers, possibly of some inferior and experimental make, is better evidence. Another man dwells at some length on the frightful scrap heaps which the Chicago, Burlington & Quincy used to have some years ago; but breathes not a word as to the fact that that sort of experience ceased some years ago, and that the recent experience of the C. B. & Q. has been exceedingly favorable; so much so, that that road is now increasing twentyfold the large number of cars which it has had in service for a year. So the meeting went on, one or two only venturing to be mildly hopeful that the future would do something for them. The New England men, if we were to judge them by the five or six persons who took an active part in this meeting, would seem to be living of choice in the world of half a decade ago, rather than of the present, and to prefer doing so. Why this should be in matters mechanical, when New England is so enlightened and progressive in other respects, we will not now attempt to surmise.

The Proposed Change in the Engineer Corps of the U. S. Navy.

In an editorial note in our issue of March 1 some mention was made of the proposed change in the manner of appointing and educating cadet steam engineers for the U. S. Navy. The text of the bill presented to Congress on Feb. 20 by Congressman BUTLER is now before us, and its passage would be an interesting event to many ambitious young engineers now in training in our technical schools.

The bill as framed enacts that the Engineer Corps of the Navy shall be composed of 12 Chief Engineers, with the rank of Captain; 15 Chief Engineers, with the rank of Commander; 55 Chief Engineers, with the rank of Lieutenant Commander; 95 Passed Assistant Engineers, with the rank of Lieutenant; 80 Passed Assistant Engineers, with the rank of Lieutenant, Junior Grade; 50 Assistant Engineers, with the rank of Ensign, and a number of Cadet Engineers, with the rank of Naval Cadets, as determined by the bill.

Until the number of commissioned officers provided for in the bill is reached ten Cadet Engineers shall be appointed on each June 30, plus the retirements and casualties occurring in the corps during the current year ending May 31. But thereafter the appointments made on June 30 shall be twice the vacancies occurring in the lowest grade for the year then ending, and one-half of these appointments is to be made from graduates of the Engineering Division of the U. S. Naval Academy, and the other half from graduates of technical schools of the United States who pass a prescribed examination. If the number of candidates, naval and civil, is greater than the number of appointments to be made, all of them shall undergo a competitive examination, to be prescribed by regulations of the Board for Examining Naval Engineers, and the appointments shall be made from those who successfully pass and in order of merit. All applications would have to be made before June 15 of each year, and the candidate must be not less than 19 nor more than 23 years of age, and pass a physical examination before a board of medical officers of the navy.

The cadets so appointed from civil life would be assigned to cruising ships for one year, and ordered for another year to the various working naval yards for such practical instruction as may be recommended by the Chief of the Bureau of Steam Engineering. Two years after the date of their appointment they shall pass another physical and competitive examination, and from those who pass, and in order of merit, the Assistant Engineers of the Navy shall be commissioned. Cadet Engineers who successfully pass their examinations, but are not commissioned, by reason of lack of vacancies, shall be honorably discharged with one year's pay. The pay of a Cadet Engineer would be $1,200 per annum at sea, $1,000 per annum on shore duty, and $700 on waiting orders and on leave.

This bill is in almost exact accord with the recommendations of Mr. MELVILLE, the Chief of the Bureau of Steam Engineering, in his report for 1888–89, and upon which we made our original comment. It proposes a minimum of change in existing laws concerning naval cadets; and in securing the best talent available, from within or without the Naval Academy, the Navy is decidedly the gainer. Under this law the best fitted young man will secure the place and the rank, as should be the case, regardless of where the training came from.

The new navy now under construction is made up of high-powered ships demanding the best talent and training in their management and maintenance; and it is evident, from the late reports of Chief MELVILLE that the present Naval Academy source of supply is inadequate to meet this increased demand. There are not enough young men selecting the staff course of steam engineering at the Academy; and one reason therefor may be the foolish but no less existing prejudice among embryo naval officers regarding the relative status of "the line and the staff." This prejudice, united with appointments based as often upon personal relations with the appointing power as upon merit, is not calculated to furnish the best material for a branch of the naval service that really requires the highest degree of technical training and natural talent.

The material introduced into the navy under the provisions of this bill would stand on a very different footing as far as the preliminary training is concerned. The methods of instruction at the best of our technical schools fully equal if they do not surpass the methods of the Government institution. But the student of steam engineering would be at the start free from all the traditions and prejudices of the Academy; and if he entered and became permanently connected with the U. S. Navy, it would be upon his merit and fitness alone; a status that no one could doubt and a position gained in direct competition with the Academy cadets.

What is wanted is not only more engineer officers, but the best engineer officers the whole country can produce; and if under the competitive examination clause of this bill the civil candidates should get all the vacancies, it would simply prove that the outside material and training is the best, and that the Academy course should be abolished. The bill is fair to all candidates, and is decidedly for the good of the service; it is a modification of existing methods recommended by the highest professional authority in the Navy, and is backed by necessity and common sense.

Aside from its influence on the Navy, the passage of this bill would decidedly encourage the study of steam engineering in this country; just as the building of our war ships has opened new shipyards and again turned our attention to regaining the position once occupied by our ships on the seas of the world. New ships without thoroughly trained men to handle them would be useless; and this bill points out one way of building up the personnel of our future navy for war and peace.

The Practice of Water-Works Engineers.

Some curious figures as to the practice of water-works engineers can be deduced from our last annual issue of the *Manual of American Water-Works*. We have neglected for some time giving these figures, and it seems somewhat late now, when the next annual issue is nearly ready for publication; but fortunately these facts do not greatly change with time.

There were in all 1,598 American and 68 Canadian water-works reported in our last annual, or 1,666 in all. In connection with these we have the name of some one or more engineers reported, either as designing, consulting, constructing or other responsible engineer, 1,580 times, the rule being that only one engineer is mentioned in connection with each works, but some of the larger works having 6 or 8 engineers mentioned as connected with them in some of the above capacities. As respects the number of works which different engineers are reported as having been connected with, the record stands as follows:

Engineers who have had responsible connection with—

	1 work only	2 works.	3 works.	4 works.	5 works.	6 works.
No. engrs.	747	84	41.	30	13	9

	7 works.	8 works.	9 works.	10 or more works.	Total.
No. engrs.	5	4	3	14	950

Deducting the 747 works built (in most cases) by local engineers who have never built other works, 203 engineers have had responsible connection with more than one works each, or 833 works in all, being considerably over one-half the total of water-works on the continent, and the surprising aggregate of 209 works have been built by engineers who have had responsible connection (generally as designing engineer) with ten or more works each.

The list of men who have been thus connected with ten or more works does not by any means give an entirely fair idea of relative professional prominence, for in many cases where large numbers of works have been built by one man they have been mostly small works, while many consulting engineers of very large practice and of great eminence have been the actual designing engineers of but few works, counting by numbers only. Thus WM. J. MCALPINE's name has been reported to us in connection with seven water-works only, yet he was actually connected to a greater or less extent with 42 different works, chiefly as a consulting engineer in regard to special points, or for a short time only, so that the present managers of the works have forgotten his service, or deem it of insufficient extent to be worth chronicle. Similarly JOHN B. JERVIS is reported to us as having been thus connected with four works only, although we know him to have been connected in a consulting capacity with many more than this. Other names will readily occur to those familiar with this branch of professional practice, as having certainly been connected in responsible capacities with more than ten works each.

With this proviso, to avoid misunderstanding, we give the following list of those who are shown

by our water-works reports to have been connected as designing, constructing or consulting engineer with more than ten works each :

J. D. Cook	26	S. H. Lockett	12
Isaac S. Cassin	24	A. A. Richardson	11
George H. Morgan	22	Percy M. Blake	10
Moffett, Hodgkins & Clarke	16	Chester B. Davis	10
H. P. M. Birkinbine	15	P. B. Perkins	10
W. B. Rider	15	M. Walker	10
Holly Manufacturing Co.	14	Total	209
M. M. Tidd	14		

One would naturally expect that most of the water-works would have been built by engineers who were or are now members of the American Society of Civil Engineers: but such is far from the case. Of the 950 different engineers who are reported as having had a responsible connection with one or more water-works, 100 only were connected with the American Society of Civil Engineers, of whom the large proportion of 15 are now dead. Of these 100, 87 are or were members, 3 honorary members, 1 a fellow, 6 juniors and 3 associates. From these figures it will at once be seen that the society is still far short of what it should be, since any society as completely representative of the whole profession as it should be should certainly include in some grade of its membership at least two-thirds of the men high enough up in their profession to have responsible charge of work on even a small water-works. These and many other like facts showing that the society is not keeping up to its opportunities and its proper scope as it might and should do, ought to be weighed with great care by the membership. We may add as another fact that the American Society of Mechanical Engineers is now distinctly forging ahead of it, not only in membership but in its house and library facilities. Its new building is far handsomer and more commodious than even the reconstructed quarters of the Civil Engineers, as well as more conveniently located, and the American Institute of Electrical Engineers, which has heretofore used the home of the American Society of Civil Engineers in an informal way, has now gone in with the Mechanicals, not only as to quarters but as to the library. The consequence of this enlightened interest in providing a library on the part of these two societies, conjoined with the hardly pardonable neglect of the American Society of Civil Engineers to increase or even duly care for its library, will be that those who want to find a really useful technical library will have to go to the Mechanical Society, unless there is a change of policy in the near future.

Of the reported contractors for water works, numbering 519 different persons or firms, 80 only are reported as having built more than one works, these 80 having built 378 works. The remaining 439 contractors are reported for only one works each. Only nine contractors are reported as having built so many as 10 or more works each, the list of these, in order of number, being as follows :

Holly Mfg. Co.	26	Fairbanks, Morse & Co.	11
Goodhue & Birnie	25	U. S. Wind Engine and Pump Co.	11
Moffett, Hodgkins & Clarke	23	Geo. H. Norman	10
Saml. R. Bullock	16	Total	147
R. D. Wood & Co	14		
Comegys & Lewis	11		

Only one other contractor has built so many as seven works, 2 have built six works each; 7, five works each; 10, four works each; 15, three works each, and 36, two works each.

We may note further that, great as has been the increase in recent years in number of water-works, this year bids fair to maintain its reputation by showing a still further great increase. We will not at present, however, attempt to summarize the showing of the forthcoming volume.

Notes by Rail.

[EDITORIAL CORRESPONDENCE.]

If one of the good old Quaker grandfathers to the present generation of Philadelphians, who has been dead and planted a half century, should by any curious chance have been only "playing possum" so to speak, like the hero of EDWARD BELLAMY'S "Looking Backward," and if, like that interesting gentleman, he should be dug up and brought to life again after his long nap, I suppose he would immediately refuse to recognize a considerable and very valuable portion of the present Philadelphia as having any claim to be considered a part of the sober, plain and "decent" city in which he and his ancestors took such pride.

One could, indeed, excuse the old gentleman if he used the very worst Quaker epithet of disapproval when he first saw the public buildings; but when he declaimed against such structures as now make the region in the vicinity of Fourth and Chestnut Sts., the pride of Philadelphia, his clamor would certainly be ascribed to a prejudice against the beautiful in architecture, which the present generation of Philadelphians are fortunate in having overcome.

I speak of this matter of the change in architecture, because it is one of the most noticeable things to a visitor who has known the city in former years, and because Philadelphia has become somewhat noted for the extreme plainness of her architecture of every sort, with the exception of a few monumental old structures like Girard College.

It would be too much to say that it does not still deserve that reputation on the whole. It seems to one riding about the city that 90 per cent. of the houses are still of brick, with white board shutters, a scrubbed brick pavement in front, slippery white marble steps, if the dwellers are well-to-do, and a cheerful outlook upon a dwelling of the same white and red aspect upon the opposite side of the street. It is a far more ugly monotony than New York's miles of brown stone fronts, although I must confess it is an honester type of ugliness than the thin slabs of stone with which New Yorkers placidly veneer the fronts of their houses.

I cannot leave the subject of architecture, which was not by any means what I went to Philadelphia to see, without saying a word about the Drexel Building. Although it well deserves praise, to give it special mention would imply a superiority over other fine office buildings in the city which may or may not exist; but a point which has struck me is that if there is a building in the world approaching it in size, with walls so nearly pure white, I should like to see it. It is a beautiful white, too. Philadelphians have an affection for white, as their ugly white door steps, shutters, window trimmings, etc., testify, and Messrs. Wilson Bros., the architects, have humored this taste in the Drexel Building; but they have so treated it that the great shining block is as pleasing as white marble trimmings on a red brick house are ugly. I am curious to know how long the structure will retain its perfect whiteness, and whether it will not grow gray and dingy in a few years. It will be a pity if it does.

Speaking of Wilson Bros., I think that the number employed in their draughting office, about 35, is the largest number in any draughting room in this country, at least I do not now recall a larger number of draughtsmen in one establishment. The Baldwin Locomotive Works have nearly as many, however. Wilson Bros. had the opportunity in designing the Drexel Building to arrange their own offices on the top floor to suit themselves, and they have a very convenient suite of offices, with such an abundance of light that no one has to work in a dark corner. One of the things that interested me most was their blue-print room on the roof. On each of the four sides is an apparatus consisting of a heavy plate glass pane sloping outward a few degrees from the horizontal, set just outside the room, so that there is a recess under it, to which the glass forms a roof, and which is open to the blue-print room. In this recess a table was hung on trunnions, and so mounted that it could be lowered away from the pane to lay on the tracing and sensitized paper, and then, by turning a crank, brought up snugly against the under surface of the glass.

In speaking of the Drexel Building it should be remarked that there was some really remarkable engineering work done in connection with it. Mr. DREXEL'S bank building occupied one of the corners; but this was originally built without reference to the seven or eight stories now piled on top of it. Messrs. Wilson Bros. underpinned the entire foundation of this bank—long before the same thing was done at the Equitable Building in New York—and by means of ornate pilasters inside the bank and trusses that really decorate the high ceiling, all of the superimposed load is taken directly to the foundations, leaving the bank walls to carry their own weight alone. The cross-walls over the large Stock Exchange rooms are also carried on high trusses ingeniously concealed in the partitions. When the mass and intricate design are considered, the architects can well be proud of the fact that in all this vast building there is not a crack or flaw of any description. The heating, lighting and ventilating plant are also a revelation of what can be done in this direction. Every room is separately ventilated by independent air-ducts, and a sheet of paper will stick to the intake register in any room, showing a constant exhaust that rapidly changes the air to be breathed. The building has three separate water supplies; roof-water for the boilers, ground-water for the elevators and city-water for office use alone.

SOME TOOLS OF THE ENGINEER'S TRADE.

I spent a very pleasant hour at Young & Sons, learning how transits are made and various other things. Mr. YOUNG tells me they made aluminum transits as long ago as centennial year—it is very interesting to note the unconscious way in which Philadelphians take that year as a chronological landmark—and have made them occasionally ever since. However, he doesn't think the coming transit will be made of aluminum; first, because it's too light; second, because the metal does not stand wear and has to be bushed with brass, and is, therefore, expensive to use; and, finally, because not enough weight is saved to be of much account anyway. Time will tell whether he is right or wrong; but whether aluminum transits are popular in 1900 or not, it seems pretty certain that a lot of other field instruments, such as reconnoisance glasses, rod mountings, and the like, will be of aluminum.

The tough "band chain," which is something of a specialty with the firm, is being used considerably for measuring long bridge spans. It is made in long lengths and graduated to order for this purpose. In the ordinary link chain made by the firm a very tough grade of spring tempered steel is used. I tried a link of one of the chains and bent it into a quadrant, and it went back as straight as before. I had an idea that the wire might snap if it bent much further, and requested a separate link to experiment on. I bent that around as sharply as I could, and so got a bend in the wire that stayed in, but the metal showed no signs of snapping, and I saw that to break it with my hands alone was going to take longer than I had time to spare! What interested me most in the shop, however, was the dividing engines, one old one, built in 1824, another in 1842, and a comparatively new one, with a 4-ft. circle, and a total error of only 2½ seconds, and that in eccentricity.

I found some engineers' instruments of quite a different sort at the works of Riehle Bros. Mr. C. E. BUZBY, the Superintendent, showed me the whole establishment, and related to me enough testing-machine lore to fill several pages of ENGINEERING NEWS. Here are a couple of points in machine design which may be of value to some engineer: In designing a piece, to take a transverse strain, which you wish to strengthen by ribs (as, for instance, the table in a testing machine), make the ribs heavy enough to take the working load without help from the table. Otherwise the member will rupture under a strain much below its real strength, as the ribs are strained beyond their elastic limit before the table begins to take much strain. Second, in packing hydraulic cylinders in which oil is used, a rubber ring is often used to set out the leather packing. The oil attacks the rubber, and it is soon worthless. A strip of walrus hide has been substituted for the rubber, therefore, with excellent results.

A very curious feature in the establishment, which greatly interested me, was a little garden and grass plot, perhaps 30 ft. square, in the centre of the works, surrounded on all sides by high brick walls. On one side was a grape trellis. The street noise was so shut out by the buildings that it was as quiet almost as a country farm.

The firm seems to be making a specialty of their vertical screw-power testing machines. Capacities of 100,000 lbs. seem to be most in demand, but machines of 200,000 lbs. have been recently built, one for the Midvale Works. This machine is driven by power, and eight different speeds can be used without shifting belts. Besides testing machines the

firm makes a variety of weighing scales, warehouse trucks and sifters, stone dressing machines, and various other work. One novelty deserving mention is the Robie ball-bearing screw-jack, made up to 30 tons capacity.

Speaking of testing machines, I wonder how many engineering schools there are which send out graduates with C. E. attached to their names who have ever even seen a testing machine. The mechanical schools are fairly well up with the times on this matter, I believe, and some of the civil engineering schools are attending to the matter properly; but a very large proportion are neglecting wholly a matter which is becoming every day of greater importance. Many institutions are, perhaps, too poor to afford even a small machine, but they could at least secure a model of a machine and a cabinet of specimens broken on an actual machine with diagrams, etc., and instruct the students as thoroughly as possibly from them.

I saw some very interesting diagrams, by the way, at the office of another maker of testing machines, TINIUS OLSEN. The Olsen machine has an attachment which makes a graphical record on cross section paper, showing the behavior of the specimen under strain, and this serves also as a valuable check upon the readings on the beam by the experimenter.

WHAT SOME OF THE SHOPS ARE DOING.

I went down to the works of the Southwark Foundry & Machine Co., expecting to see something worth seeing, and I was not disappointed. Mr. GOOD, the Secretary of the company, showed me through the works, and gave an interesting account of their growth, which seems to have been a steady one. Gradually the firm has drifted into making a specialty of the heaviest class of machine work, and their facilities for turning out and fitting up the heaviest castings are equalled by only a very few establishments.

The product in which the firm seem to take most pride, and which is one worth being proud of, is the well-known Porter-Allen automatic steam engine. The first thing I noticed on entering the shop was the cylinder and bed plate of one of these huge motors being fitted up. It had a 54 × 56 in. cylinder, is to use steam at 85 lbs. pressure, and is to run at 100 revolutions per minute. That means a piston speed of 933 ft. per minute. How popular this engine is may be inferred from the fact that the Southwark works are now building two of the size just noted and two only a little smaller for a single establishment. The engines of the Porter-Allen type now under way at the Southwark works represent a total of no less than 18,000 to 20,000 H. P. The largest cylinder of this type of engine built at these works was a low-pressure cylinder for a compound engine 75 ins. in diameter.

Another huge casting in the machine shop was the cylinder casting for the U. S. cruiser "Maine." Very careful work is put on these Porter-Allen engines. The valves and seats are all carefully scraped. All pins in the valve motion are thoroughly case hardened and then ground to fit a standard gauge. Such careful fitting is far more important in engines of these large sizes, where a stop for repairs may mean the stoppage of work on which hundreds of men are employed, than in the engines of smaller powers. It is expensive, but the extra expense can well be afforded.

In the foundry they were building up the cores to some of these enormous castings, a task of no small magnitude. Castings up to 100,000 lbs. weight have been poured here. The largest ladle carries 35,000 lbs. of molten iron and is swung along at the rate of 200 ft. per minute by a Sellers bridge crane driven by a tumbling shaft. The cores for engine cylinders in the foundry looked like brick towers and were in number not a few. Another machine of which the firm has made something of a specialty is the centrifugal pump. Large sizes of these pumps have been furnished for nearly all the government dry docks. One was being cast in the foundry and the pattern for another was in the wood shop.

The general arrangement of the shops was of great interest to me. The company has found it necessary to enlarge its facilities and is now putting up a machine shop which will be nearly double the size of the present one. It will be directly on the site of the old one and will include besides a good slice of what has been the shop yard. As stopping work is out of the question, the new building is being built over the old one without disturbing it more than is necessary. In handling these heavy castings a "short haul" is necessary to economy, and, therefore, the end of the machine shop next the foundry will be fitted up to handle the heaviest work, which will thus have to be moved but a short distance after it leaves the mold before it is ready for shipment.

The new machine shop will have a traveling bridge crane of 65 ft. span, designed for a working concentrated load of 200,000 lbs., and driven at a speed of 200 ft. per minute by a Sprague electric motor. The riveted truss for this crane was built by Cofrode & Saylor, at Pottstown, and was just being hauled into the yard on the afternoon of my visit.

I have not seen shops anywhere so well lighted as those at the Southwark works. Mr. GOOD says that one foot of skylight is worth two feet of sidelight, and evidently believes that it does not pay to hire workmen to fumble over their work in dark corners. In the new shop about half the roof will be of glass. The Sturtevant system of forced draught heating is used and gives the best of satisfaction. The floor of the new shop will be of two layers of 2½-in. plank laid crosswise directly on well-packed foundry sand, which contains considerable iron and acts as a preservative of the wood from decay—a point well worth bearing in mind.

In the boiler shop I saw some large marine boilers which will furnish steam to run the pumps at one of the Government dry docks. A monster locomotive type boiler, with Belpaire fire-box was nearly finished. It is to carry 185 lbs. pressure, and will weigh 90,000 lbs. when ready for shipment. As I looked at this heavy weight, and also at some of the 90,000 lb. engine bed castings, I wished I could be able to impress them, to speak metaphorically, upon the minds of some of our railway bridge engineers. How many of the men who are paring down weights of bridge members, or figuring out wheel loads to the hundredweight, would be anxious to have one of these heavy castings or big boilers billed over the line of railway under their charge? And are such loads likely to grow less frequent in the future? If I were to draw a moral, I should say "stone-arches, riveted girders and steel trusses, built to stand any load that can come upon them."

I must not forget to mention the provision the firm has made for fire protection. The part of the city where the works are located has grown much faster than the water mains supplying it, and there is therefore very little pressure in the city mains. A stand pipe has been built in the shop-yard 103 ft. high and 11 ft. in diameter, which is kept filled by a steam pump in the works taking water from the city mains, and supplies pressure to fire plugs all through the works. The valuable records of the drawing room are too important to take chances with, and a fire-proof vault has been built in which they are stored.

I shall have to defer the relation of the remainder of my Philadelphia experiences to another week, but I must take space to mention the cordial reception I met with everywhere in the Quaker City. From the "men of iron" to the "men of sand," all gave me a welcome which was fully appreciated, and spoke good words of ENGINEERING NEWS. ***

(TO BE CONTINUED.)

CORRESPONDENCE.

The San Diego Sewerage Works.

SAN DIEGO, Cal., March 6, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Owing to absence from home my attention has only recently been called to Col. GEO. WARING'S communication published in ENGINEERING NEWS of Dec. 14, 1889, in which he attempts a crushing rejoinder to the report of the Board of Public Works of this city on the San Diego sewerage system, designed and supervised by him. Neither we as a board, nor any of its members individually, have any quarrel with the Colonel. Our quarrel is with his faulty and defective sewerage system, and the object of our report was simply to give facts and correct misrepresentations. The sewerage system of San Diego and its operation have created very general interest in the United States, judging from the numerous letters of inquiry I have received in regard to it, and it has seemed to me due to the profession that the erroneous impressions in regard to the system and its management that might be conveyed by the Colonel's letter be corrected.

The Colonel does not do himself credit when he insinuates that the motive of our criticism was professional jealousy, or a desire on the part of the Board to curry political favor by flinging mud at the city's creditors to avoid payment of debt, or that the management of his sewer system ever was, or is now, in "unfriendly" hands; for it is all untrue. It is characteristic of Col. WARING, as near as I can observe, to disclaim responsibility for any defects that appear in his work, by hook or by crook. His disclaimer in this case consists in the fact that his contract with the city, under which he was to have exclusive control of the construction of the sewers and receive five per cent. of the cost of the system for his services, was discovered to be in conflict with the State law, which required such work to be done under the supervision of the City Engineer and Street Superintendent. This change of authority is sufficient ground in his opinion to relieve him from any further responsibility as to the character of work done, notwithstanding the fact that his representative, Mr. M. G. WHEELER, was on the works from beginning to end, and had practical charge of them and sufficient authority to put a stop to bad or dishonest work, if any such came under his observation. He was there for the purpose of seeing that the work was done according to plans and specifications. That was the precise object in view when the City Trustees agreed to pay Colonel WARING 5 per cent. on the cost, and actually did pay him $18,437 as commission, besides a considerable amount for traveling expenses. This large sum was not given simply for the plans, for WARING agreed to furnish those for $1,000. But, the City Trustees having adopted his system, paid him this amount in order to have a guarantee that the system would be perfect: in order to insure its construction directly under Colonel WARING'S supervision, and in order to fix his responsibility for it. If WARING is not responsible for the system as constructed, he should have declined the fee that was the price of his responsibility, and he should be too modest to make any further claim for unpaid balances, and too honest to insinuate that this city repudiates a legitimate claim.

Concerning the "harbor reservoir," which has proven such a wretched and costly failure, and which Col. WARING still defends as a proper and practical portion of the system, it is unfair to charge that it might have worked successfully under more "friendly control." Every person in charge of it since it was built has always used his utmost endeavors to have the thing work properly. Every possible effort was made to aid its working; but when, after the lapse of a year, it had accumulated such a mass of filth as to become a crying nuisance, create disease and threaten a pestilence, it was high time for "friendly control" to take it in hand and modify it. Fancy an open cess pool 200 ft. square, filled with solid sewage, rotting and festering in the sun for a year, with daily accumulations piling up in it and located midway between New York and Jersey City, on the line of the ferries, and your readers may get an idea of Col. WARING'S "harbor reservoir" between San Diego and Coronado.

The measures we took to abate the nuisance have been perfectly satisfactory and successful. They consisted of the plan recommended in our report. After scraping out 750 cu. yds. of solid filth, we built a flume across the reservoir 8 ft. wide, to the height of the reservoir walls, lined with surfaced redwood plank, and with the bottom on a grade of about 1 per cent., connecting its lower end with the gate house, whence the sewage was discharged as before through 600 ft. of 30-in. pipe, terminating in 18 ft. depth of water at low tide. The sewage was confined to the flume, the "reservoir" was abandoned, the "automatic" outlet gate was removed and sent to the junk heap, and a simple gate substituted for it, whose sole function is to keep the rising tide out of the flume and main sewer. The flume has been in use nearly six months, and still works well, notwithstanding Col. WARING'S prediction of failure, and his characterization of it as "ignorant tampering with the main outlet." The operation of the sewage in this flume has demonstrated the absolute folly and impracticability of Col. WARING'S entire plan of harbor reservoir as an outlet for the sewers. Notwithstanding the smoothness of its sides and bottom, its grade, its limited area of cross-section as compared with that of the main reservoir—one twenty-fifth—all conditions favorable for flushing and freeing itself with every ebb tide, there is a constant deposit of sludge in the bottom of the flume amounting to about 1 cu. yd. daily. This is material which refuses to move after it once lodges, and has to be scraped out periodically. It consists very largely of grape seeds, paper, rags, bones, etc., with a little sand.

Col. Waring would not persist in defending his "harbor reservoir" plan if he could see it in operation, or if he would study sewage a little more closely. Surely, if he would reflect a little, he would admit the absurdity and impossibility of the idea of obtaining a current over any portion of a tank 200 ft. square sufficient to pick up and carry along sewage matter deposited on the bottom by opening a circular valve at one side, 30 in. in diameter, no matter what the difference in level between the water inside and outside the tank may be. Still less is it possible to empty the tank of liquids and solids when the valve is arranged to open very deliberately, and only at rare intervals, and to remain open for a few moments only. I can imagine such a scouring current taking place only by the sudden removal of the whole side of the tank at low tide.

The "training channel" (across the harbor reservoir, presumably) which Col WARING suggests that he might have added to perfect his plan, would have operated in a

measure to confine the sludge or heavy sewage, and aided its discharge through the outlet, but it would have been inefficient to prevent floating *fæces* and other light sewage matter, of which there is a large proportion, from being carried out to one side of this training channel, and driven by the wind into the corners of the reservoir further from the outlet, forming a heavy scum or thick crust floating on top, adhering to the sides of the reservoir, never moved by outflowing currents, festering in the sun, and finally settling in a reeking mass to the bottom, there to remain immovable, except by the force of a strong current. No "training channel," short of one with sides high enough to prevent any sewage from passing beyond the limits of the channel, would correct this objection, and such a channel, with a cover to keep the sun out, would be precisely what we have made in the flume that Col. WARING says "there is no reason for, no reason in."

Col. WARING thinks that he really did make an error in filling the harbor reservoirs so high as he did, but that if he had left it so that there would have been, say two feet of water over the bottom at low tide, it would have been all right. He does not suggest lowering the outlet pipe an equal amount, but even had this also been done the effect would have been a more thorough and complete deposit on the bottom of the tank of all sewage matter held in suspension, as the discharge of the sewer would have always been in dead water, where its velocity and carrying capacity would have been entirely lost. The ultimate result would have been the same as at present, although it might have postponed for a year or two the discovery and exposure of the nuisance and its cause.

In all his plans and discussions Colonel Waring seems to treat sewage solely as a liquid, and to ignore the solids which it carries and which are most troublesome to deal with. Theoretically it would be the correct thing to empty liquid sewage in a large tank, dilute it with salt water and discharge it on the outgoing tide, but practically the solids refuse to be treated in that way. They will not be diluted, but must be hurried along to the final discharge and never permitted to rest.

I sincerely hope Col. WARING will never experiment with another community as he has with this, and that he will learn by our sad and costly experience that "harbor reservoirs" for sewage, or any sort of sewage reservoirs, are like cesspools of every kind, dangerous and objectionable. In short, to quote his own words, there is "no reason for, nor reason in them."

I meant to have said something more about the sewer system in general, to answer many inquiries, but this letter is already too long. I can say in a word, however, that there is nothing about the system to be specially proud of—although it can be made to answer for many years to come. The inclined inspection pipes are practically valueless, and should have been replaced with manholes.

JAS. D. SCHUYLER.

SAN DIEGO, CAL., March 6, 1890.

English and American Locomotives.

CORVALLIS, Ore., March 1, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: However much you may feel disposed to put the editorial extinguisher upon me, by declaring this discussion at an end, in fair play, you will, I am sure, allow me a reply to the "broad generalizations" of your criticism of my letter of Jan. 29, especially if it can be shown that there is a self-contradiction in your logic, that gives an emphatic "yea and amen" to the idea I was struggling to express, viz., that the English builder incorporates every improvement, however slight, that can aid in producing a perfect locomotive, the question of cost being regarded as a secondary consideration.

In your criticism you say in effect:

All track is bad. The truck is indispensable for the worst track. Conclusion: In degree it is good for the best track. The point is well made; and, true to their endeavor, the English makers are embodying this most valuable device. Then you proceed to apply the argument again somewhat as follows:

All boilers are bad, interposing between fire and water a medium for transmission of heat that is more or less slow to carry it. Copper transmits 1-20 more heat than iron. Conclusion: The use of copper in the fire box is an instance of "pure and unalloyed conservatism of the Chinese kind." I congratulate you, Mr. Editor, that your logic is so singularly free from any such Mongolian taint.

But if I admit, as any prejudiced mind will, the world over, that the average American is brilliantly inventive, I do in the same breath most earnestly protest against the injustice and untruth of the charge of English conservatism, that comes so freely from your editorial pen. How unjust it is, I will prove by asking your readers to turn to the timely illustration of Stirling's express engine in your issue of Feb. 22. You state that this is another instance of the approximation of the English to the American type of locomotive. Now, at the risk of appearing presumptuous, I distinctly challenge that statement; and, taking this illustration as my case, I will show that for one single approximation there are nigh a dozen points of distinct divergence from the American standard eight-wheeled locomotive.

I. Points of approximation.

1. The truck—an approximation in principle only; the details of its construction, allowing for additional lateral play, and its general set up, giving it strongly marked characteristics of its own.

2. Four-coupled drivers—an approximation that is merely apparent; since there are hundreds of English four-coupled engines that have been running for thirty years; and the '87 to '90 types have nearly all discarded the clattering outside coupling rods, in favor of single drivers, aided by the steam-sanding apparatus.

II. Points of divergence.

(1.) Straight-topped boiler, as distinguished from wagon topped; no steam-dome, and substitution of internal steam-pipe—all with a view to reducing pressure evenly throughout the boiler in drawing off steam, and so avoiding priming.

(2.) No sand-box on top of boiler; the weight being placed low down on the frame, where it should be.

(3). No bell or cow-catcher, though these differences are due to perfect track arrangements, rather than to any excellency in the locomotive itself.

(4). No extension smoke box; its necessity being removed by judicious firing and a mild exhaust.

(5). The plate frame, chosen for its better adaptability to resist the maximum strains to which it is subject.

(6). Inside cylinders, minimizing sway, with its disastrous side blows against the rail. The Great Northern, Caledonian, L. & N. Western—leading roads—at first tried engines with outside cylinders, and have some running yet that are from twenty to thirty years old; but their latest types of '87 to '90 have all returned to inside connections, except the Webb compound, in which the exigencies of the case demanded two outside high-pressure cylinders.

(7) The draught-deflector on furnace door, feeding the necessary oxygen to the half-burnt gases—of the existence of this last we have no evidence from your sketch, but I will answer for its being there, since I never saw a locomotive built on Chinese conservative principles that was without it.

(8) Steam reversing gear — an advance upon the cumbersome lever that needs no better recommendation than a trial of it.

(9) The copper fire box saving one-twentieth of the heat; that is to say, saving one ton of coal in twenty.

(10) The steam sanding apparatus, enabling this engine to dispense with the crushing and destructive loads on drivers, customary in American practice, and placing in the engineer's hands a reserve of tractive force for use in heavy work.

(11) Wrought-iron forged wheels.

Thus we see that, for one point of assimilation, we have eleven points of divergence of the standard English from the standard American type. For each of these points I will say this much, that, try them by the argument with which you prove the necessity for the truck and the copper fire box, and you will find that they are each in its degree conducive to the make-up of a perfectly efficient locomotive—even to the forged wheels, with their ever so slight advantage over the cast, in respect of breakage.

And I ask, not for the sake of mere argument—to which, of course, you would never descend, but simply in order that you may give your readers a more intelligent appreciation of Anglo-Chinese conservatism, or the gradual escape from it, as embodied in the subjects of those forthcoming illustrations which you promise us. I ask you to take, not one of these eleven points for all, but each for itself, and prove, first, wherein it is an approximation to the American type; failing this, second, wherein it is a mere exhibition of a blind Chinese conservatism; or failing again, I would most respectfully ask you to disprove my assertion that these differences in practice reveal as a whole a masterpiece of English design, as free from Chinese conservatism as the English mind is free from prejudice in judging of anything excellent in a locomotive, whether it bear the stamp of Manchester, Philadelphia, or New Jersey.

J. BERNARD WALKER.

[We are pleased to give our lively correspondent his say, but he will allow us to add that his main argument is quite apart from the purpose. The features like the plate frame in which the English locomotive continues to differ radically from the American are old features; those which are new, of any fundamental importance, are those which make it approximate to the American type, the most notable and salient of which are the leading truck and the equalizing levers. The coupled drivers are almost as old as the locomotive itself in both types. The straight top boiler is and has long been largely used here, and like several other of the items of our correspondent's letter is a mere minor detail, not affecting the essential character of the machine. As for the copper fire-box, transmitting $\frac{1}{20}$ more heat does not by any means mean saving $\frac{1}{20}$ of the fuel, and if our correspondent will refer back to the data given on that subject he will see that even that saving is a doubtful one. The extra heat transmitted may be much less than that. It has never been demonstrated experimentally that there is any saving to our knowledge.—ED. ENG. NEWS.]

English and American Railway Practice in Mexico.

Ferrocarril Interoceanico de Mejico,
JALAPA, MEX., Jan. 12, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: As an Englishman and an English engineer, must ask for room to reply to Mr. JONES' extraordinary letter in your issue of Nov. 16.

He states that (in English practice in Mexico) all "curves are calculated with even radii and odd deflections." Before making this statement he should have at least taken the trouble to get information on the subject. He evidently does not know that from Vera Cruz to Las Vegas—190 kilometres—the only curves not laid out by even deflections (American practice) were those whose radii were chosen, in a few places, to especially fit the ground or follow a contour. These surveys were made under an English chief by English and American engineers.

"In grades, no equation is made for curvature." In reply to this I will only give an extract from the specifications. "The maximum gradient allowed is 2¼ per cent., but it is understood that no gradient more severe than 1.75 per cent. shall occur on curves of 100 metres radius; 1.90 per cent. on curves of 110 metres radius, 2 per cent. on curves of 120 metres radius and 2¼ per cent. on curves of 150 metres radius."

The next paragraph is such that I am surprised to see it in ENGINEERING NEWS. Most of it is utterly false. It is true that after location a ditch or furrow is dug from station to station, and I was unaware that this was confined to English practice. If it is, let me strongly recommend it to the notice of American engineers, as any one can then follow the line through woods or over prairie, even if every stake has been lost. It has been of immense service on this portion of the line, for all P. C.'s, P. T.'s, and other points can be found with but little trouble, if they have been driven into the ground deep enough to escape the notice of the natives.

I have never heard of any case where a large stake had been set at the end of each kilometer. I have been on construction on this road for over a year, and it is news to me hear that this constitutes slope staking. Personally I know of no case where work has been opened without stakes, unless from failure on the part of the engineer in charge. To make estimates from slopes taken for contour maps is entirely foreign to English practice. On every portion of this road, on which I have worked, estimates have ben made from slope stakes (per American practice) from carefully taken and plotted cross-sections or from actual measurements. Mr. JONES adds: "Very rarely (only on sharp curves and high dumps) does the engineer test the completeness of the work by an application of his instruments." As such a statement carries nonsense branded on its face, it calls for no remark.

That the American contractor says, "If my borrow pit looks neat, I have no fear of my work being rejected," is surely an extraordinary statement, since all the work (on the Interoceanic) is measured in excavation, and even if the borrow pits were in such a shape that they were difficult to measure, no engineer would fail to receive the work if the banks were properly constructed. And if the pits were so badly taken out that they could not carry the drainage, it would be an easy matter to enlarge or deepen them. Of course, neat borrow pits add vastly to the appearance of the work, and an engineer very properly tries to have this done.

Mr. JONES is correct in saying that no temporary bridges are put in, and furthermore, wherever practicable, the road is ballasted 18 centimetres deep before track laying. It would make this too long to inform Mr. JONES why the work was not begun at Vera Cruz; he can easily find out if he takes the trouble. It was a question of administration, not of engineering.

I will only add that if Mr. JONES can prove as facts what I contradict, he will only be giving the experience of some incompetent and unreliable man, who is more despised by his own countrymen than by Mr. F. MEREDITH JONES.

C. DIMOND H. BRAINE,
Asst. Eng. F. C. Interoceanico.

[We agree with Mr. BRAINE that the trenching process between stakes as a preliminary to construction, to which he refers, is a good one. It is also by no means unknown to American practice, and certainly far from a proper subject of reproach against English practice.—ED. ENG. NEWS.]

A Simple Method of Sheet Piling.

NEW YORK, March 4, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: On page 129 of your issue of March 1, 1890, you describe a simple and efficient mode of sheet piling, shown in Fig. 1 herewith. Perhaps the following simple method may be new to you and to some of your readers. I adopted it about ten years ago with entire success, never having seen it used or heard of its having been used previously.

We were building masonry piers, 60 or 70 ft. in height, and needed sheet piling for coffer dams. The nearest saw mills were over 500 miles distant, and no mills for tonguing and grooving were in the vicinity; but fortunately we had plenty of 9 × 12 in. yellow pine timber and of 3 in.

plank. We cut out strips 3 × 3 ins., and nailed to the 9 × 12 in. timber two of these strips to form the groove, and one strip to form the tongue, using 6 in. wrought spike slanting upward, and this mode proved a complete success.

While writing on this subject, I would say that the old-time way of shoeing piles and sheet piling with iron used to annoy me, until the idea occurred to me that a piece of

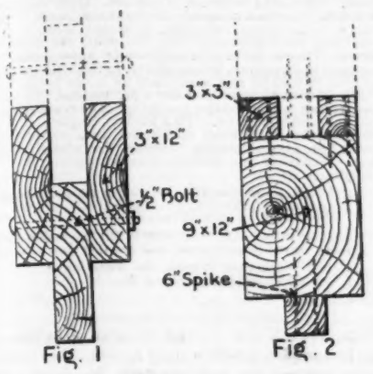


Fig. 1 Fig. 2

thin wrought-iron, bent by a "former," and merely nailed to the point of the pile, would prevent abrasion as well as the cumbersome methods in vogue, and I have used iron ¼-in. thick with entire success under hard driving.

ROBERT L. HARRIS, C. E.

[The last suggestion seems to us particularly worthy of note, as universally applicable. The extemporized sheet piling described, is good; but would probably take somewhat more careful sawing and more nailing than the compound plank sheet piling first described.—ED. ENG. NEWS.]

The Proper Location of a given Frog, when the Turn-Out Angle is Fixed.

PORTLAND, Ore., Jan. 24, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR:—In railroad construction it sometimes happens that a tangent is produced on ahead from the P. C. of a curve already built, and that the only frog on hand will not fit the angle made at the crossover.

The question arises: Where must the frog be placed so as to give a minimum change in curvature?

In Fig. 1, *C E H* is the curve already laid out. The tangent *C E*, extended on to *J*, crosses the located curve at *G*.

If, for the sake of uniformity along the line, or from necessity, the only available frog is one that does not fit the turn-out angle, some trouble will likely be experienced before the frog can be properly placed.

The correct position of the frog is such that, while one of its branches coincides with the main tangent, the other, extended, becomes tangent to the curve.

Should the frog be located more toward the P. C. a reverse curve will result, while if put farther out the distance, as well as the curvature, is increased; therefore, because a straight line is the shortest distance between two points, the first position is the best one.

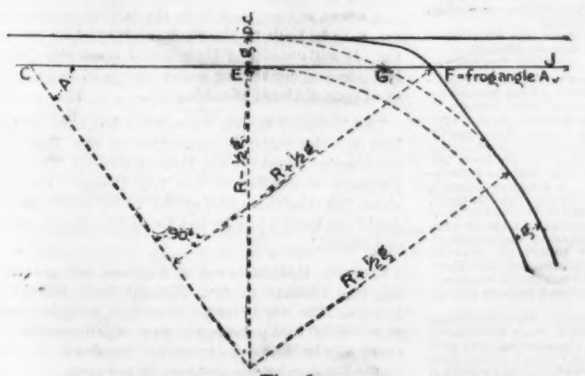


Fig. 1.

In Fig. 2 *F* shows the true position of the frog. If placed at *F'* the curvature, as well as its length, is increased, while if put at *F''* a reverse curve results.

In Fig. 1 let *R* = radius of curve.

g = gauge of track.

A = angle of available frog.

Then will the frog distance from the P. C., measured parallel to the straight track, be equal to *E F*, but *E F* = *C F* − *C E*, whence we obtain by substitution—

$$E F = \frac{R + \frac{1}{2} g}{\sin A} - (R - \tfrac{1}{2} g) \cot. A,$$

which is a general formula for all cases, whatever the frog angle or the degree of the curve.

For every frog distance there will be two frog angles that will satisfy it.

Should the frog angle be less than the angle made at the crossover, the outer branch of the tongue produced

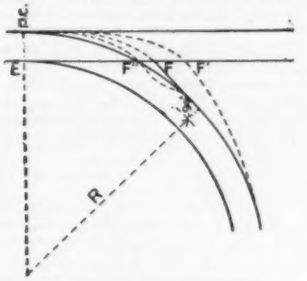


Fig. 2.

becomes tangent to the main curve at a point between the frog and the P. C.; but when the frog angle is greater, it becomes tangent when produced in the *opposite* direction.

The following table, which was calculated by the foregoing formula, may be extended at will so as to embrace all probable curves as well as the whole range of frogs.

TABLE OF FROG DISTANCES FROM THE P. C. MEASURED PARALLEL TO STRAIGHT TRACK. GAUGE: 4' 8½"

Degree of curve.	Radius.	No. 4. 14° 14'	No. 5. 11° 26'	No. 6. 9° 32'	No. 7. 8° 10'	No. 8. 7° 10'	No. 9. 6° 22'	No. 10. 5° 44'	No. 11 5° 12.	No. 12. 4° 46'
1°	5729'.6	734.0	597.0	498.0	441.8	396.2	360.9	334.0	312.0	294.0
2°	2864'.9	376.0	311.0	267.4	238.0	217.9	201.6	190.0	175.2	175.8
3°	1910'.1	257.3	214.7	187.5	169.3	157.1	148.5	142.0	138.0	136.0
4°	1432'.7	197.7	166.9	147.7	135.2	127.2	121.9	118.6	116.7	116.0
5°	1146'.3	161.9	138.2	123.8	114.8	109.3	105.5	104.3	103.7	104.1
6°	955'.4	148.1	119.1	107.9	101.1	97.4	94.4	94.8	95.1	96.2
7°	819'.0	121.1	105.8	96.5	91.3	88.9	87.8	87.9	89.0	90.5
8°	716'.8	108.3	95.3	88.9	84 1	82.4	82.2	82.8	84.3	86.3
9°	637'.3	98.3	87.3	81 3	78.4	77.4	77.7	78.9	80.7	83.0
10°	573'.7	91.0	80.9	76.0	73.8	73.4	74.2	75.6	77.8	80 4

When a number of frogs are on hand, and the degree of the fixed curve is known, a moment's inspection of the table gives the one to select; for we have only to look along the horizonal line opposite the given degree till the *shortest* distance is found. The corresponding frog number is at the top of the column. GUS. D. AVERY.

Standard Instructions for Engineers.

BICKLEY MILLS, La., Feb. 14, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I think there is a woful lack of a good set of instructions for use of engineers in surveys, location and construction, barring, perhaps, those used on the Southern Pennsylvania R. R. In order to stimulate exertion in this matter, I hereby offer to be one of ten to give my $5 towards a prize of $50, to be given to the engineer who shall present the best set of instructions under a general competition. The judges to be three in number, one of whom shall be the editor of ENGINEERING NEWS, the other two to be selected by the subscribers to the prize. The successful instructions to be published in your journal. The details to be worked out hereafter should the scheme meet with success. Yours truly, EMILE.

[It would not be a bad idea to work up such a set of instructions, should there be enough interest in the matter to warrant it. Should nine others send us the same offer, we shall be pleased to do what we can to call public attention to the matter, and doubt not some very good sets of instructions would be received. But, in the meantime, we would commend to engineers the very excellent set of "Regulations for the Engineering Department During Construction," prepared for the South Pennsylvania R. R. Co. by Mr. WM. F. SHUNK, C. E. They are now published with CROSS' Field Book and sold by this journal for 25 cts.—ED. ENG. NEWS.]

The Water Supply of Plainfield, N. J.

NEW YORK, March 13, 1890.

TO THE EDITOR OF ENGINEERING NEWS: In your issue of Feb. 22, you stated that the "Engineers recently engaged by the city to ascertain the extent of Plainfield natural water supply, have reported that it is doubtful if water can ever be obtained in sufficient quantity by boring."

As engineer for the city, superintending the construction of the proposed works, please permit me to say that no such report emanated from me, and that moreover it is untrue. The report that I made stated that from present indications, I believed the company would find a sufficient quantity of water of satisfactory quality. As the false report is unjustly injuring the company, I trust you will kindly make this correction. Yours truly,

RUDOLPH HERING.

[The statement made was taken from a newspaper item. As no one can know better than Mr. HERING of the actual state of affairs, we trust his correction will settle the matter.—ED. ENG. NEWS.]

Notes and Queries.

R. U. asks: You have within your reach information as to the highest chimney stack in the world. I said it was Tennants' of Glasgow. Another gentleman gave the name as Townsend's. Will you take the trouble to give the proper name and oblige?

The Townsend chimney, Glasgow, 474 ft., is as yet the highest in the world, we believe. A very tall one, 452.6, at Halsbrucke, Saxony, is now building, as noted last week.

J. E. S. asks: Please tell me in your answers to queries if a gate at grade crossings closed and opened by passing trains has ever been used, and if such a gate, simple in construction and certain in operation would be of any value to the inventor, or be likely to come into use?

Such a device, "simple in construction and certain in operation," would be certain to come into almost universal use, and return millions to the inventor: but the trouble is, attempts without number have been made to construct such a gate and never with real success, nor do we believe success can ever be achieved at reasonable cost, the obstacles are so serious. Most of the inventors of these devices don't think of half the difficulties until forced on them by experience. Partial success has been several times achieved.

Notes on the Argentine Republic.

In our issue of Feb. 22, we published some interesting notes on affairs in the City of Buenos Ayres as compiled for us by Mr. WILLIAM F. SHUNK, C. E. Since then we have seen an official report prepared by the same veteran engineer, and as it contains matter of interest to many of our readers as presenting a graphic picture of an interesting country, the author has kindly consented to the publication of such portions as are not of a strictly private nature. We give it as follows:

BUENOS AYRES, Aug. 13, 1889.

To DOCTOR J. M. THOME, Director of the National Observatory, Cordoba:

My dear Sir: Before leaving this country I desire to thank you for generous and courteous attentions during my brief sojourn in it, and to respond also to your wish for some general impressions of my visit. These impressions are strong and vivid, though limited in range, my tour having covered only the round trip by rail between Buenos Ayres and Cordoba, and short excursions in the vicinity of those cities.

The great plain had a complex effect on me. To the cursory eye it was a monotonous green expanse, level-rimmed like the sea, dotted with ponds, traversed by occasional living streams, here and there a hovel to sleep in, a scattering village, flocks of sheep, herds of cattle, a man on a galloping horse; a rather sombre scene, oppressive because of its extent and desolation. But the modern traveler cannot restrict his view to the visual aspect only of such a scene. The eye of the mind sees beneath the surface, beyond the level horizon and down the vista of the future. Thus contemplated, it requires no prophetic inspiration to foretell the development awaiting that vast arable field. In my own case retrospection alone would dictate prophesy. Thirty years ago I rode through a prairie region west of the Mississippi River, resembling this in soil and climate, but destitute of the railroad, the flocks, the herds, the villages and the horseman, which is now a group of rich and populous counties, gridded with highways and railways, thick beset with homes and harvests and prosperous industries. Conditions being similar, results should be similar. They must be similar. Under wise laws, the van of immigration has already arrived on this field. It needs only wise laws concerning the aquisition and tenure of land, education and taxation, which presumably are

either in force or in certain prospect, to insure the following of that van by a host which shall change the face of the continent within the period of an average lifetime. To be brief, my compendious impression of the Campo, taking that word to signify the whole interior plain of the Republic, is that the coming wealth of Argentina lies hidden just the depth of a furrow beneath its sod, an immeasurable and inexhaustible fund, awaiting only the plowshare to turn it up.

The City of Cordoba was a bright surprise. To alight from the wide Pampa in such a diversified theatre of busy life and various architecture, seated in view of the mountains and half girdled by a perennial river, was as if a man, walking the desolate strand, should stumble suddenly

"On a huge cup of gold
All rich and rough with stories of the gods."

That was my first impression, deepened rather than defaced by after observation. You must try to pardon a little enthusiasm here, as Cordoba was my first introduction, since attaining man's estate, to a characteristic city of the South, to the homes of the Romans, and to exquisite structural forms born of the Greek genius before Rome grew great. From the comparatively narrow, lofty and unembellished facades of our severer climate—wanting, indeed, the beauty of proportion upon which the beauty of ornament would be congruous—my transfer was direct to the elegant dwellings and stately public edifices of your charming capital, a most pleasing sight to see, not only because of contrast, of novelty, of classical association, but because also of their inherent grace, symmetry, fitness and tasteful adornment.

The public works, lately completed or still in hand, could not fail to engage the attention of a stranger. The magnificent avenue and plaza General Paz, the theatre, the Provincial Bank, the churches, the vast preparations for urban enlargement, the huge lime and brick furnaces, the river walls, boulevards and bridges—these and other great undertakings indicated on one hand the wealth and enterprise of the citizens, on the other the sagacity and energy of the government. Most striking and instructive of all, however, to the writer, were the irrigation works, for the complete examination of which he is indebted to the obliging kindness of his excellency, Don Marcos N. Juarez, Governor of the State, under whose administration they have been executed. Of the plan of distribution I could form no judgment during our brief trip; but the prominent details of construction within the mountain region, the arcade aqueducts, the dam for the distributing reservoir and that for the storage reservoir must approve themselves to all intelligent visitors, both as works of art and as fine examples of hydraulic engineering. This superb improvement will pay many fold its cost in substantial benefit to the country. A diamond has been thought the best illustration of concentrated value. That reservoir dam seems to me a better one. In both cases common materials are crystallized into forms of wealth; but, for each linear metre of its crest between those cañon walls, the dam will conserve three million cubic metres of rainfall, every metre of it more serviceable to mankind and of more intrinsic worth to the people of Cordoba than the Koh-i-noor itself. On the parapet should be inscribed an honorable legend containing the names of its originators, promoters, builders and engineers.

Not least among the creditable institutions of Cordoba, certainly not least interesting to the writer, as having been transiently of its household, is the National Observatory. We of the far North knew of its existence and its fair repute; but, before examination of the record, I had no suspicion of the fact, which it is hoped your coyness will not prohibit my noting, that this unpretending station, during the brief period of its existence, has contributed more largely to the topography of the heavens than all its contemporaries of civilization united; and has made Argentina honorable and of good report in the brotherhood of useful science the world over.

I find it difficult to epitomize my impressions of Buenos Ayres. Cordoba anticipated for me what otherwise might have been peculiar in its aspect and its people, leaving me chiefly sensible of magnitude and multitude. After seeing its rural resorts, its residency suburbs, its plazas, paseos and gardens, its colleges, schools, theatres, hospitals, churches, banks and other public buildings, the arterial system of tramways, the nervous web of telegraph and telephone, the thronged and animated thoroughfares by day and by night, the new port works, the crowded commerce of the Riachuelo, the stupendous activity in building and in trade, my summary conclusion is, that here we have indeed a great cosmopolitan city, equipped and adorned already to take rank with the world's famous capitals, full of life and intelligence, and having a growth in prospect co-ordinated with that of the growing country whereof it is the political and commercial metropolis, that, in the event, shall probably make the boldest reasonable prediction, at this time, ridiculous for its inadequacy.

Two things have struck me, as inviting remark, which those longer resident here may not have thought remarkable.

First: The marvellous crop of speculative schemes and associations, due partly to the financial condition, partly to the rapid evolution of the country. They are condemned by some as vicious extravagances. To myself they rather seem to be unavoidable incidents of development. Forecast among the few must always precede forecast among the many. By such enterprises the world is led along—over rough ground, perhaps, but still onward; thus taught the ways of effective organization and fruitful industry. Only the fittest can survive for lasting benefit. Many must fail, with results more or less disastrous, and, it may be added, educational; for man, in every line of progress, treads darkling a briary wilderness, guided mainly by his hurts and mistakes; but the Nation will come through it all strong and great, the stronger and greater even for its childrens' errors, as active, impulsive youth emerges into healthful manhood. 'Tis the energetic child, like our little Jamie, prossing, in the lack of better occupation, to "stuff his Aunt Nelly's prayer book up the Devil's nose," who makes most ventures, tumbles oftenest, thrives best and walks soonest. Alchymy left a precious residuum, wrought afterwards into the brilliant fabric of modern chemistry. The residual effect of these tentative projects must in like manner, I think, undoubtedly be to form the basis of a well ordered and prosperous industrial economy.

Second: Buenos Ayres seems to be a bazar almost exclusively for the sale of foreign wares. To find native productions we must seek obscure shops and the market plazas. This may be readily accounted for, and justified, as a transitory stage in her advance. To view it otherwise, much more, to accept it and conserve it as a permanent condition, would, I think, be seriously to err. In this age of the world peoples should be self-supporting, if possible, as to all their primary needs. They should stand erect, not be held erect by others, as the wisest Roman said. Peace is yet a precarious calm; storm always contingent. We are bound to take care that, if it come, it shall not, so to speak, quench our hearth fires. So rational a community as the people of this country may be expected, therefore, in due season, to find themselves able to utilize, and to seize the occasion to utilise others of their natural bounties as they do their clay and quarry stone. Home manufactures will gradually appear with the gradual occupation of the great interior, and the next generation, living, as now, in homes of native material, and feeding on native bread and meat, shall also be clad in their own native fabrics, ride or walk on their own leather and sit or sleep on their own wood. That their territory is lacking in the useful minerals would seem to indicate, with particular emphasis, that they should do the most by those natural resources wherein they abound. It seems a matter only of less or more time when, not with a diminished, but with a vastly augmented commerce, they will add other agricultural productions to the staples now sent abroad and compete in the markets of the would with their leathers, textile fabrics and cabinet ware at least.

From Buenos Ayres I made an excursion to La Plata and Ensenada. The beauty of the state buildings in La Plata was a feast to the eye almost equal to Cordoba. At Ensenada the engineer in charge was pledged to other engagements and unable to accompany us; but he kindly placed his steam launch at our service, and we had the pleasure of an afternoon voyage around the new port. An artificial channel about four miles long, and varying from 300 to 600 feet wide, protected by piers of timber-trestle and broken rock, leads straight from deep water in the river to the wharves of the inner harbor and to the entrance of the dock, which I should judge to be half a mile long and 600 feet wide, inclosed by massive granite walls. The whole work is admirable for simplicity of plan, sound engineering and staunch construction. In connection with a first-class railroad, yet to be built, it is likely to be a favorite approach to the capital from the sea.

As to the railroads generally, so far as opportunity has been given me to see them, being accustomed to the North American system, this English system looks barbarous in some respects; the passenger cars rude, dirty and hearselike, the conduct of transportation antiquated. Terminal yards are spacious and well laid out, their buildings magnificent; field tracks rickety and irregular, as must needs be the case, in a measure, with such construction under heavy traffic. Toad-stool castings are used as substitutes for costly timber ties. They serve the purpose better than would be expected, but demand constant attention, and the track force appears to be inadequate either in numbers or efficiency.

On one of the trunk lines, single track, an engine was derailed, the forward wheels two feet out of place, the rear ones just off, the tender still on, both upright. I passed it the second day after the accident, and three days more were counted necessary to re-rail it. On the Pennsylvania R. R., four track trunk line, near my home, a consolidation engine and tender ran square across the passenger tracks, nearly capsizing; the heavy freight train behind it jumbled into a complicated wreck for several hundred feet. This occurred about 8 A. M. By 10.30 A. M. the wreck had been handled and all tracks were clear for traffic.

The contrast between the grand terminals and the shabby field work put me in mind of certain Maryland cousins of ours. Jim was a farmer, a modest, blushing recluse. On an occasion of unexpected noon visitors, he did them the grace of appearing at dinner in a fine cloth claw-hammer jacket over his work-a-day waistcoat and breeches, an emergency gentleman; but, like Milton's Sin, "ending foul in many a scaly fold." With the cruel wit of a lawyer, and to the shy subject's painful confusion of face, Johnny directed the attention of the company to Jim's outfit as "an incongruous mix of agricultural filth and oriental splendor."

Nevertheless these roads are immensely valuable as instruments of development. The people of Argentina seem to me to have been wise in granting liberal concessions and in attracting foreign capital to such investments. If I am rightly informed, these concessions are subject to the condition that the franchises shall expire and the roads become the property of the Government within a specified period, not exceeding 99 years in any case. This is an eminently prudent condition. Some companies are moving to have it cancelled. I think it a point of very grave importance that it should in no instance whatever be yielded. It is demonstrably the interest of all civilized states eventually to own and contro the highways of internal commerce. The movement of progress is manifestly in that direction. By virtue of this vital clause in the concessions Government may assume control at the appointed time, without jar, equitably, seasonably and serviceably to the republic.

So much for my short flight through this auspicious land. God speed to Argentina.

WM. F. SHUNK,
Civil Engineer.

To the foregoing may be added one or two supplementary impressions. The city of Buenos Ayres occupies a nearly level plateau looking northward over Rio de la Plata from an elevation of about seventy feet. This plateau bluffs down eastwardly to a low flat, partly swamp, sparsely built upon, and a plump mile wide, lying between the compact city and a devious stream from the south, averaging 300 ft. in width, which has been deepened to form the port of Riachuelo. A dredged channel, six miles long, admitting vessels of twenty feet draught, connects the port with navigable water in the river, here forty miles from shore to shore and tawny like the Mississippi. The Riachuelo is lined with wharves and commercial houses on the hither side; with tenements, hovels, small shops, boat yards and goat pastures on the other, and packed for two miles along the business front, three to five deep, with shipping of all maritime nations except the Great Republic.

Walking that front, of a gloomy Sunday, when the colors were flying, lonely, homesick, surfeited with outlandish ensigns, which only reminded me of the missing one; and were, indeed, offensive in a sort, "like Priam's refuse sons when the Fates borrowed Hector;" suddenly, as I rounded a turn in the river, right before me, broadside to, shapely as if she had grown to her proportions like a bird or an outstanding elm, lay a five-masted Yankee schooner, with Old Glory, rippling in the wind, at her mast-head. Children! I tell you true, it seemed absolutely to perfume the air—apple blossoms and piney woods blended together. Such heavings and rotations did it set agoing in me, I could almost have cried for joy of the sight. That was my strongest impression of all in Argentina. Only one flag in five hundred. But that one sufficed. It irradiated heaven and earth.

Another strong impression, the effect of my whole voyage,—not a new one, but the deepening of an old one—was, that the most pathetic phenomenon in this universe, and the goodliest creature we know anything about, is that goodly creature, Man; respectable—or, if you reject that, pitiable surely, even in his degradation; helpable and to be hoped for at his lowest; and of such inextinguishable, essential worth that I believe the criminal lawyer, the selfish dude and the desperate tramp themselves, the very rot of our civilization, after a few years in Crusoe's island, would board the rescuing ship—not decently clad, belike—but, in the Pauline sense, graciously "clothed upon" with all the fair humanities, each rejoicing the others and thanking Heaven for his comrades.

His tendency is not to sink, as those good, wrangling Calvinists in your city lately seemed to believe. If we find him down, be sure he was thrust down and is held down. His native tendency is upward. Here and there, no doubt, "a churl compact of thankless earth," whom most of us have met; reducible, it would seem, only by penal fire; but exceptional, like the deaf, the blind, the idiotic. The rule is health, and faculty answerable. He responds in kindliness to the kindly, in faithfulness to the faithful, naturably and irresistibly as ocean to the moon. 'Tis the law of his manhood and a joy besides. He can no more refuse it than a daisy can refuse the breath of spring and sulk under the turf. 'Tis a kind of impiety to think the contrary—a flouting of Nature too, whose record shows him ever ascending through the whole track of time. Whatever the discouragement, during that long discipline,

"Quick, generous from his youth, his spirit rose,
In many a glittering crest and gleaming fold,
Hydra-like to its hindrance."

So may he go on, still overcoming, till the noble prayer of Robert Burns is answered, and the day dawns at last,

"When man to man, the warld ower,
Shall brithers be for a' that!"

Feb. 12, 1890. W. F. S.

THE LAKE VIEW WATER TUNNEL, near Chicago, will be completed before July 1, 1891, the time set in the contract for building 5,000 lin. ft. of a 6-ft. tunnel. Mr. S. G. ARTINGSTALL, the Consulting Engineer for the tunnel, has reported on the present progress, and says that if the order were at once given to locate the inlet shaft between 5,000 and 10,000 ft. east of the shore shaft, the entire work could be completed within the time specified for building the 5,000 ft. He does not advise a temporary inlet shaft. But the Mayor has decided that the condition of the water fund will not warrant going out further than called for in the original contract.

A 12-IN. STEEL CONDUIT, 15,400 ft. long, is wanted by the city of San Bernardino, Cal, with bids to be in before April 8. It is for a feeder from a reservoir to supply the street mains. The pipe is to be 12 in. diameter inside, and in 24½ ft. lengths, made of four large and three small plates of 42 ins. to a course. The material is to be mild steel, with a minimum tensile strength of 60,000 lbs. per sq. in. All straight seams will be double riveted and round seams single riveted. The weights will be: 3,300 ft. No. 10 steel; 6,000 ft. No. 12 and 6,100 ft. No. 4. All seams, straight and round, must be calked; the pipes coated with the purest quality of Santa Barbara asphaltum, and tested in each length before coating to 220 lbs. per sq. in. for the No. 10; 200 lbs for the No. 12, and 150 lbs. for the No. 14. The lengths are to be laid with drive or shrink joints, which will be made by removing the asphaltum coating for 4 ins. on the outside of the end of one pipe and on the inside of the other, and the outside pipe is then expanded by heat and at once driven in place. After making the joint is to be chipped, calked and repainted with asphaltum.

A STEEL FLUME, said to be the largest in the country, is to be built by the Spokane Hydraulic Mining Co. It will consist of 4½ miles of steel pipe, 22 ins. in diameter, conveying water for gold diggings in the Cœur d'Alene, Washington.

THE DETROIT RIVER BRIDGE CO. has been authorized by the railway committee of the Dominion Parliament to bridge the Detroit River. The plan proposed is similar to the Tay Bridge. But how about the American half of the river, which would doubtless need a bridge too, to make the Canadian end useful.

LONDON BRIDGE is one of fourteen bridges crossing the Thames in the Metropolitan District of London. The whole traffic over these bridges is said to be 400,000 foot passengers and 80,000 vehicles for every day in the year excepting Sundays. Of this traffic London bridge sustains 30 per cent.

THE JUSTIN EXPLOSIVE CARTRIDGE has been again tested within the week at Utica, N. Y. It was fired from a 9-in. English Blakesley rifle gun. On the first test a shell weighing 280 lbs. and containing 5¼ lbs. of dynamite was fired. The charge of powder was 12 lbs. The shell struck the cliff a third of a mile away and one half of the dynamite exploded. The second shell had the same weight and contents, 20 lbs. of powder being used. The third shell weighed 300 lbs. and contained 8¾ lbs. of

dynamite. The charge was 25 lbs. of powder. This shell did great execution on striking the rock. The fourth and final shot was the largest ever fired in the gun, 35 lbs. of powder being used. The shell, weighing 350 lbs., or 100 lbs. more than the regulation, contained nearly 19 lbs. of the best dynamite.

THE TEST OF THE GUNS OF THE VESUVIUS, on March 13, is understood to have been satisfactory in all respects. Each gun fired one explosive shell weighing 510 lbs. and loaded with gun-cotton. The contract range of one mile was exceeded with a pressure of 700 lbs. per sq. in. Shot No. 1 contained 204 lbs. of gun-cotton, and overshot the mile buoy by 300 ft. in 11 seconds, and exploded 5½ seconds after failing into the water. Shot No. 2 weighed 504 lbs., and in 11.7 seconds fell 500 ft. beyond the mark; it exploded one second after impact, and threw a column of water and mud 300 ft. high. Shot No. 3, in range and time of explosion, was a duplicate of No. 2. The explosive charge was the same in each.

THE GRAYDON DYNAMITE GUN, which is now being built at Birmingham, England, to compete with the ZALINSKI gun, is to be 15 ins. in calibre, and it is claimed that it will throw a 600-lb. charge of dynamite three miles. Lieut. GRAYDON, U. S. Navy, is personally superintending its construction, and believes it will be ready for a test about May 1.

EXTENSIVE SHIPBUILDING WORKS AND STEEL WORKS are to be established at Sparrow Point, near Baltimore, Md., by the Pennsylvania Steel Co. The first work will be the construction of two steel steamers to bring ore from Cuba for the company's works. The steel works will be designed especially for turning out material for shipbuilding. The works will cost $500,000, and will be large enough for the construction of eight steamers at once.

THE TEHUANTEPEC SHIP RAILWAY is revived again, in a proposition made by Mr. MATEO CLARK to the Mexican Government to renew the concession of Capt. EADS, which concession has now nearly expired by limitation.

THE EADS MONUMENT PROJECT is taking definite form in St. Louis. A committee has been appointed to take charge of the matter, and a concert is to be given to create a fund as a nucleus. The Liederkranz Society and other musical bodies will produce HANDEL'S "Creation," which has been selected as being particularly appropriate in view of the broad scope of Capt. EAD'S inventive genius.

IMMIGRATION is showing a slight tendency to increase, and to increase in the least desirable class—Bohemians, Hungarians and Italians. The total immigration for January (always small) is about 10 per cent. greater than last year; for the 7 months ending with January, about 5 per cent. less than last year. But in January, 1890, about twice as many of the three objectionable classes noted came as came the year before.

THE "ELECTRICAL ENGINEER," the oldest journal of its class in America, and long and favorably known in its monthly form, is to be converted into a weekly publication from the date of April 1 next. Mr. T. COMMERFORD MARTIN and Mr. JOSEPH WETZLER, both well and widely known in connection with electrical journalism, will be connected with the *Engineer* in its new form, and their names in connection with those of Mr. F. L. POPE and Mr. G. M. PHELPS are a sufficient warrant of the character of the reorganized journal.

THE ENGINEERS' CLUB, OF NEW YORK, though little over a year old, is gaining numbers so rapidly that it has been deemed advisable to seek larger quarters than No. 10 W. 29th St. This is the club made up of engineers and those connected with them, and should not be confounded with the technical American Society of Civil Engineers.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

New York Central & Hudson River.—The report of this company for the first quarter of this year shows the following results from operations, as compared with the same period of the previous year:

	1890.	1889.
Gross earnings	$8,527,258	$8,033,478
Operating expenses	5,653,221	5,501,108
	2,874,037	2,532,370

Cleveland & Western.—A press dispatch from Lima, O., says:

General Manager Risley and John H. Semple, Chief Engineer of this company, have just completed a trip over the line. It was made in order to map out the work preparatory to changing the track from narrow gauge to standard gauge. The new standard gauge locomotives, now being built in Pittsburg, will arrive in Delphos on the 1st of April. The steel rails will commence to arrive next week, and work will then begin in earnest. Trains are now on the line distributing ties and bridge material.

Ohio & Northwestern.—This railroad, extending from Cincinnati to Portsmouth, Ohio, has been sold by United States Marshal Simonds for $900,000 to the Philadelphia Investment Co.

Gettysburg & Harrisburg.—President J. C. Fuller, of this road, is quoted as follows in regard to the proposed extension from Gettysburg to Washington:

The details of the plans are being arranged, the course of the road having been practically decided upon. The road runs through Westminster, and uses the Pennsylvania track for entrance into Washington. There will be a branch line, which will connect with the Northern Central, and this will give a short and through line to Baltimore. The citizens of Ellicott Co., Md., have offered $100,000 for building the Baltimore branch through their place, but it would make too expensive a route.

Grand Trunk.—This company is pushing the work of double-tracking its line. Early in April work will begin on the laying of a second track on the division between Toronto and Hamilton, Ont. Tenders are now called for the earthwork required to widen the cuttings for the second track, and to place the excavated material in embankments, on the section between Dufferin street and Mimico, in Toronto. The total length of the line is 40 miles, and it is believed that it will cost about $750,000. The work of double-tracking the line between Toronto and Montreal, which has been in abeyance since the fall, will be renewed in the spring. Out of 331 miles of line 142 have now been duplicated, and there is between 80 and 90 miles under construction. The present summer will, it is expected, see this finished and contracts let for the rest of the work.

Pennsylvania, Poughkeepsie & Boston.—The principal offices of this company have been moved from Goshen, N. Y., to 411 Walnut St., Philadelphia, Pa. The road is now in operation from Campbell Hall, N. Y., to Slatington, Pa., and surveys are in progress for a further extension to Harrisburg, Pa.

Sandy River.—A project is reported to be on foot to extend this road from Farmington, Me., via Farmington Falls, Chesterville, and Turner to a connection with the Grand Trunk Ry. at Auburn or Lewiston, Me.

Projects and Surveys.

Northern Maine.—Geo. P. Wescott, of Portland, Me., President, writes us that the greater part of the right of way and about $100,000 of other local aid have been secured in aid of this enterprise. The company proposes to build a railway from a connection with the Maine Central R. R. at Mattawamkeag, Me., via Patten and Houlton, to Presque Isle, Me., a distance of 116 miles. According to the surveys, which have been completed, a very favorable route has been secured; maximum grade, 60 ft. per mile. The object of the road is to develop Aristook Co., which contains a large amount of fertile land. The principal business of the road will be in lumber, farm produce, and passengers. Frederick Danforth is Chief Engineer.

Cumberland & Washington.—The bill authorizing the lease of the Chesapeake & Ohio Canal to this company has now passed both houses of the Maryland Legislature and now needs only the Governor's signature to become a law. The Cumberland & Washington R. R. Co. was organized last month to build a railway from Cumberland, Md., to Washington, D. C., and to acquire the Chesapeake & Ohio Canal for a railroad. Enoch Pratt, of Baltimore, Md., and Asa Wilson, of Cumberland, are among the incorporators.

George's Valley.—Bids are now being received for the construction of this Maine road. The road is projected to run from Warren to Union Common, Me., eight miles, with the intention of being extended ultimately to Belfast, 20 miles further. Henry A. Hancox, of Hudson, Mass., is Chief Engineer.

Washington County.—There seems to be a prospect that this enterprise will be revived and steps taken towards its completion in the near future. Press dispatches state that engineers are in the field surveying for a route and securing right of way, and that work on construction will begin soon. The company was chartered in 1887, with E. W. Serrell, President, and J. S. Chase, Chief Engineer, to build a railway from Greenwich, N. Y., to Rutland, Vt., a distance of 56 miles. A portion of the road was surveyed in 1888, and since that time the matter has been dormant.

Nipissing & James Bay.—This company is before the Dominion Parliament asking a subsidy of $3,200 per mile in aid of its proposed road. The length of the road will be about 350 miles. A full description of the enterprise was given in our issue of May 11, 1889.

Williamsport Junction.—Chartered in Pennsylvania to build a railway from a point on the Williamsport & North Branch R. R., in Loyalsock Township, to a point on the Pine Creek Ry., in Lycoming County, a distance of 7 miles. Geo. L. Sanderson, of Williamsport, Pa., is President.

Fort Erie & Point Albino.—A press dispatch says: "A project is on foot for the building of a line of railway along the shore of Lake Erie, on the Canadian side, from Fort Erie to Point Albino, Ont., a distance of 10 miles. The preliminary surveys are already completed and an application for a charter will be made to the next Canadian Parliament. At the recent session an application was put in, but a sufficient time had not elapsed before that body adjourned. The railway is designed to connect all the resorts on the lake shore from Fort Erie to Point Albino, and will be backed by plenty of capital."

SOUTHERN.—Existing Roads.

South Bound.—It is stated that the money necessary to build the line from Savannah, Ga., to Blackville, S. C., has been secured, and that a construction company will be organized soon to build the road. Mike Brown, of Barnwell, S. C., is President.

Wilmington, Onslow & East Carolina.—The grading on this road has been completed from Wilmington to Jacksonville, N. C., a distance of 50 miles, and it is stated that the track will be laid at once.

Central R. R. of Georgia.—Work is making good progress on the extension of the Savannah & Western R. R. from Savannah, Ga., west. Tracklaying is now completed to Conley, Ga., 27 miles east of Sterling, where connection will be made with the Savannah, Americus & Montgomery R. R. It is expected that this section of 27 miles will be completed by May 1.

Columbia, Newberry & Laurens.—Tracklaying has now been completed a distance of 15 miles from Columbia, S. C., and is progressing at the rate of one-half mile per day. Work, it is stated, will soon commence at Newberry and be rapidly pushed.

Georgia Southern & Florida.—A report is in circulation that this company will build a branch from a point near Melrose, Fla., to a connection with the projected Tampa, Tallahassee & Western R. R., a distance of 50 miles.

Louisville & Nashville.—This road is to be double tracked from Birmingham to Decatur, Ala., a distance of 84 miles. The work, it is stated, will begin at once. On account of the large amount of side-track on this section of the line, only about 40 miles of grading will be necessary for the additional track. Engineers are now at work surveying the line for the extension of the Anniston & Atlantic R. R., from Sylacauga to Longview.

Georgia Pacific.—It is announced that the division of this road between Atlanta and Birmingham, Ala., 167 miles, will be double tracked. Work will begin at Atlanta and Austill Junction, and it is expected to have the work completed in 18 months.

Seaboard Air Line.—Contracts for the construction of the Georgia, Carolina & Northern R. R., from the Savannah River west to Atlanta, Ga., are now being let. The headquarters of the company have been changed from Chester, S. C., to Atlanta, Ga. W. Temple is Chief Engineer.

Abbeville & Way Cross.—The contract has been let for constructing this road which is to run from Abbeville to Way Cross, Ga., 93 miles, and work is now in progress. F. C. Hand, of Abbeville, Ga., is Chief Engineer.

Union Point & White Plains.—It is stated that the money necessary to make the surveys for the proposed extension of this road from White Plains to Tennile, Ga., and that surveys will begin soon.

Richmond & West Point Terminal Co.—It is stated that this company will build a belt railway at Atlanta, Ga., at the cost of $200,000. The line will run from the Georgia Pacific R. R. at Howell's station, around the city to the Central R. R. of Georgia. The company will also build a new depot at the cost of $250,000.

Projects and Surveys.

Mobile Fair Grounds & Western Shore.—Chartered in Alabama to build a line of railway from Mobile, Ala., to City Point. Among the incorporators are: Jas. W. Baird and Wm. C. Gaynor; both of Mobile.

Louisville Southeastern.—This company has been chartered in Kentucky to build a line of railway from Louisville, via Mount Washington, to Smithville, Ky., a distance of 25 miles. The route is stated to be through a very productive portion of the country now without railway facilities. Judge W. B. Hoke, of Louisville, Ky., is interested in the enterprise.

Danville, Mebane, Pittsboro & Southern.—A press dispatch states that work has been commenced on this road, which is projected to run from Danville, Va., to a connection with the Raleigh & Augusta Air Line R. R., in North Carolina.

Bristol, Elizabethtown & North Carolina.—At the election held at Bristol, Tenn., March 6, the citizens voted in favor of the appropriation in aid of this road. Bristol has now subscribed $240,000 in aid of the enterprise. The road is projected to run from Bristol to Mountain City, Tenn., with a branch from Elizabethtown to Erwin, a total of 75 miles. Geo. S. Bruce, of Bristol, is Chief Engineer.

Charleston Belt Line.—A press report from Charleston, S. C., states that the stockholders of the Union Cotton Compress & Wharf Co. have confirmed the sale of their property to the Neill McDonald Co., of New York, at the price of $150,000. The purchasers have already paid $25,000 guarantee on the property. The city has granted the purchasers the right of way through the streets, and

they will build a belt line railroad running around the East Shore water front, connecting with all the wharves.

NORTHWEST.—Existing Roads.

Manitoba.—A recent issue of the Toronto *Globe* contains the following data concerning the various railways now in progress of construction and projected for early construction in the Province of Manitoba:

The Canadian Pacific Ry., Souris branch, was graded last fall from Kemnay to Melita, and the rails laid and trains run as far as Souris, which is now a thriving town, with mills, elevators, stores, churches, schools, etc.; tracklaying to recommence in the spring.——The Morris & Brandon branch of the Northern Pacific is built and railed from Morris to within a few miles of Brandon, and has been operated during the winter to Souris City, or, as it is now called, "Wawanesa."——The Southwestern branch of the Canadian Pacific Ry. is to be extended this year from Glenboro, via Millford, to a junction with the Souris branch at Souris.——The Pembina branch of the Canadian Pacific Ry. is to be extended this year from Deloraine to a junction with the Souris branch at Melita.—— The Souris branch of the Canadian Pacific Ry. is to be pushed from Melita to the Souris coal fields, the whole of this line to the coal reserve having been located last fall.——The Morris-Brandon branch of the Northern Pacific is to be completed to Brandon, a distance of four miles, from where it stopped last fall.——The Northern Pacific is to build from Belmont, a point east of Souris City or Wawanesa, west to the Souris coal reserve. A party is out now locating this line.——The Northwest Central R. R. completed 50 miles last fall, running from Brandon to Rapid City, and from thence westward about midway between the main line of the C. P. R. and the Manitoba & Northwestern R. R. Trains have been running over this line.——The Northern Pacific & Manitoba also built from the boundary to Winnipeg, and from Winnipeg to Portage la Prairie.

Pacific Short Line.—A press report states that tracklaying is now progressing at the rate of 1 mile per day. It is stated that sufficient material is on hand to complete the line to Plainview, Neb. Construction is in progress on the division from Plainview to O'Neil, 40 miles.

Projects and Surveys.

Freeport, Ironton, Mauston & Northern.—The city of Mauston, Wis., has voted to issue bonds in aid of this enterprise. The road is projected to run from Dexterville to Lone Rock, Wis. Jeff I. Heath is President.

Little Falls, Mille Lacs & Lake Superior.—This company has been granted the right of way for its line through the Mille Lacs Indian Reservation in Minnesota.

St. Louis, Chester & Grand Tower.—Incorporated in Illinois to build a railway from East St. Louis through the counties of St. Clair, Monroe, Randolph and Jackson, to the town of Grand Tower. The principal offices of the company will be at East St. Louis. The directors are: S. Dwight Eaton, of Burlington, Ia.; H. M. Pollard, of St. Louis, Mo.; Wm. Barrett, of Chicago; Thos. M. Chase and William Brown, of East St. Louis, Ill.

SOUTHWEST.—Existing Roads.

Kansas & Arkansas Valley.—At a meeting of the stockholders of this company, recently held, a resolution was adopted to build at once a number of branches; and, in accordance with this resolution, an amendment to the charter has been filed with the Secretary of State. This road, which is a part of the Gould system, now extends from Van Buren to the northern boundary of the Indian Territory, and one of the branches will commence on the boundary line of Arkansas and the Territory near Fort Smith and run north, crossing the Arkansas River to a line of the railway at Cherokee Junction, on the boundary line between the State and the Territory, the line to be six miles in length and to cost, with bridge, $530,000. Another branch will be from Wagoner, on the main line, thence west and northwest to Guthrie, through the Fort Supply military reservation, to the western boundary of the Indian Territory. Another branch will run to Oklahoma City, through the Fort Reno reservation, and connect with the Fort Smith, McAllister & Western Railway near Wichita. The length of these extensions will be 440 miles, and the estimated cost, $3,000,000.

Union Pacific.—It is reported that the Central Kansas R. R., running from Leavenworth to Miltonville, Kan., 166 miles, will be changed to standard gauge and extended from Miltonville to Trescot, Kan., a distance of 40 miles.

Texas & Pacific.—This company has engineers in the field to survey a line from Provincal to Lake Charles, La. The object of the road is to develop the timber lands along the route.

San Antonio & Aransas Pass.—It is stated that construction will soon begin on the branch from Kennedy to Laredo, Tex., 150 miles. The survey has already been completed.

Projects and Surveys.

Wichita & El Paso.—Incorporated in Kansas to build a railway from Wichita to some point on the south line of Harper County, a distance of 65 miles. The directors are: W. A. Thomas, L. D. Skinner, Geo. L. Rouse, A. W. Oliver, and H. L. Pierce, of Wichita, Kan., and F. J. S. Turley and Percey A. E. Hood, of Runnymede, Kan.

Atlantic & Pacific Short Line.—It is stated that surveys will soon begin for this road, which is projected to run from Salina, Kan., to Colorado Springs, Colo. J. E. Hills, of Denver, Colo., is one of the directors.

St. Joseph & Excelsior Springs.—This company has made application for a charter empowering it to build a railway from St. Joseph to Excelsior Springs, Clay Co., Mo., a distance of 60 miles. It is stated that surveys will begin at once.

Pleasanton Northern.—The citizens of Pleasanton-Atascosa Co., Tex., are agitating the project of building a railway from that place north to a connection with the San Antonio & Aransas Pass R. R. at either San Antonio or Elmendorf.

Galena, Guthrie & Western.—This company has been granted the right of way for its line through the Indian Territory.

ROCKY MT. AND PACIFIC.—Existing Roads.

Utah Central.—Amended articles of incorporation have been filed consolidating the Salt Lake & Eastern, the Salt Lake & Fort Douglass, and the Utah Western railways, all in Utah, under the above name. The consolidated lines, with the proposed extensions, will aggregate 250 miles. The various extensions will be built at once. The extensions are as follows: On the Salt Lake and Eastern R. R., from a point near Park City to the head of the the Provo River, 25 miles; from the main line to Heber City, 8 miles; and a line up Weber Cañon, a distance of 20 miles. The Milk Creek branch will be extended 15 miles. The Utah Western R. R. is graded from North Ninth St., in Salt Lake City, to Manahansett Beach, and work will commence tracklaying as soon as the weather will permit. The line will also be extended eastward around the foothills and mesas to a connection with the Ft. Douglass & Eastern R. R., making a belt line around Salt Lake City.

Northern Pacific.—This company, it is stated, will build a branch from Durham, Wash., north to the Snoqualmie River, a distance of 18 miles. A branch to the South Prairie Creek coal mines, 3 miles long, is also talked of.

Union Pacific.—A Pioche, Nev., press dispatch gives the following description of the extension from Milford, Utah, to that place.

The first 75 or 80 miles of the road from Milford presents no difficulties whatever; it is nearly as level as a floor, and contains but two curves. The contractors on this part of the road, delayed by bad weather, are now rushing things generally, and the engineers in charge state that the road will be at Desert Springs by the middle of April. No heavy work or grading is encountered on the line until Clover Valley wash is reached, where, for about 25 miles before reaching Meadow Valley wash, no less than 100 bridges must be built, and 8 tunnels run, one of which is 650 ft. in length. One of the bridges also is upward of 600 ft. long, and three sets of timber high. Added to this is an immense amount of side cutting, so rough is the country, and the character of the work being granite, or a conglomerate sandstone, difficult to work, the necessity for a large force of workmen in order that good progress may be made, can be readily seen.

Sub-contractors' camps now extend from a point about one mile above Clover Valley to Dutch Flat, 17 miles, which latter place is but 3 miles from Meadow Valley wash. At present not more than 35 men are working at any of these camps, except that of Daniel Lyons, where 150 or more are engaged, nearly all at rock work. Each tunnel will be 18 × 22 ft., and the roadbed or grade will be 15 ft. on top.

Anacortes, Spokane & Eastern.—The name of the Seattle & Northern R. R. has been changed to the above. It is stated that work will soon begin on the further extension of the road. F. A. Hill, of Anacortes, Wash., is Superintendent.

Astoria & South Coast.—An officer of this road is quoted as speaking as follows in regard to the progress of construction:

We have a large force of men at work, and the road will be pushed to completion. The road must be finished by September, 1891, and there is no question but that it will be through long before. At present a crew of between 100 and 150 men are at work on the Astoria end, and they are making good progress. There is also considerable scraper work being done at the Hillsboro end. The rails for the track between Young's River channel and Seaside are on the ground, and we will get other material as fast as we want it. The people along the line of our road are enthusiastic, as they have the fullest confidence in our determination to push work.

Oregon & Washington Territory.—It is announced that the necessary subsidies have been raised to assure the construction of the line from Gray's Harbor to a connection with the Northern Pacific R. R. at a point near Centralia.

Projects and Surveys.

Pecos River.—E. B. Bronson, of El Paso, Tex., has sent us the following information concerning this enterprise:

The road is projected to run from the Texas Pacific R. R. north through the Pecos River Valley to Roswell, N. M., a distance of 185 miles. Engineers are now in the field locating the line. The route is very favorable, with easy grades and curves. The road is projected in the interest of the Pecos Irrigation & Investment Co., which is carrying out a large irrigation enterprise in the valley. The road is to be built by private capital. Contracts will probably be let in about two months. J. J. Hagerman, of Colorado Springs, Colo., is President, and H. H. Cloud, of Eddy, N. M., is Chief Engineer.

Palouse & Spokane.—This company has been granted the right of way through the Nez Perces Indian Reservation, Idaho.

Umpqua Railroad & Improvement Co.—John C. Drain, of Drain, Ore., President, has furnished us with the following information concerning this enterprise:

The road is projected to run from Drain, via Elkton, Scottsburg and Gardiner, to North Slough, on Coos Bay, Ore., a distance of 75 miles. About 50 miles of the line have been surveyed. The work is generally light; one tunnel 930 ft. long, no large bridges. The right of way has all been secured and land for the stations and terminal facilities. The contract for building the road has been let to W. G. Steel, of Portland, Ore., who sublet to B. C. Heald, of Drain, Ore. The road is to be completed July 1, 1891. Henry Thielsen, Portland, Ore., is Chief Engineer.

FOREIGN.

Mexican Pacific.—A press report states that tracklaying is progressing at the rate of one kilometer per day on the Pacific end of this road.

Mexico.—It is announced that the necessary money has been secured to build the proposed railway from Pachuca to Tampico. The route is through a fertile region and there will be much heavy work. Surveys, it is stated, will commence at once. Richard Honey, of the City of Mexico, Mex., is the concessionaire.

RAPID TRANSIT.

Electric Railways.—The Concord St. Ry. Co., of Concord, N. H., has been authorized to adopt electric traction.

At Athol, Mass., the Athol & Orange St. Ry. Co. is preparing to put in the power plant for the electric road.

The Augusta & Summerville Ry. Co., of Augusta, Ga., has awarded a contract to the Thomson-Houston Electric Co., for the electrical equipment of its road.

A franchise for an electric railway has been granted at La Grande, Ore. Two miles will be built this year.

At Ellensburg, Wash., a franchise for an electric railway has been granted to a company with a capital stock of $10,000.

The Port Townsend Electric St. Ry. Co. has decided to adopt the Thomson-Houston system. The track will be laid with 40-lb. girder rails. The Pullman Car Co. has an order for 3 cars. Merrifield & Myers, of Portland, Ore., have the contract for grading and tracklaying.

Street Railways.—The Columbia St. Ry. Co., of Washington, D. C., proposes to extend its road south toward Anacostia.

The North Minneapolis St. Ry. Co., of Minneapolis, Minn., will build a line from Rosedale to connect with the Penn Ave. line at 34th St.

The Texas St. Ry. & Land Co. has been organized at Boston, Mass., to acquire, build and operate street railways in Texas. The company has an office at Fort Worth, Tex., and owns street railways in Austin, Gainesville and Fort Worth. President, Thomas J. Hurley of Fort Worth, Tex. Capital stock, $250,000.

Elevated Railways.—The Seaside & Brooklyn Bridge Elevated Ry. Co., of Brooklyn, N. Y., has had its route laid out by the Eighth Rapid Transit Commission. The line will be an extension of the Fifth Ave. line of the Union Elevated Ry. Co., and will extend from Greenwood cemetery to Fort Hamilton. The plans have been prepared by Mr. O. F. Nichols, engineer of the railway company, and approved by Mr. Samuel R. Probasco, engineer to the commission. The company has a capital stock of $1,000,000.

At Chicago, Ill., the Chicago & Evanston Elevated Rapid Transit Co. has been incorporated by John Cudahy, Fridolin Madlener, J. A. Wolford, G. F. Baldwin and C. W. Parrdidge. Capital stock, $12,000,000.

HIGHWAYS.

Illinois.—A meeting was held at Springfield, March 10, to further consider the subject of a hard road from the city 6 miles east to the National Cemetery at Camp Butler The committee reported estimates on the cost of a brick-paved military highway at $65,000, one of the same material at $73,500, and one of macadam at $37,000. Resolutions were passed urging Congress to pass Senator Cullom's bill making an appropriation of $50,000 for the road.

Tennessee.—The Lewisburg & Caney Spring Turnpike Co. is taking steps to complete 10 miles of the road at once and to open two gates on the same.

Pennylvania.—There is said to be dissatisfaction over the condition of the Philadelphia Turnpike between Chester and Darby. The road is scarcely passable. Since the Grand Jury condemned it, there has been some little improvement. The prospects are that an effort will be made to have the highway purchased by the county and the system of toll taking abolished.

Ohio.—The jurors attending court at Youngstown, who are from nearly every township in the county, held a meeting March 10 and discussed the proposition to bond the county for $1,000,000 to build macadamized roads. The feeling was almost unanimous against the bonding of the county, it being claimed that the farmers would not be willing to pay the increased tax. According to the estimates made, if the proposition to bond the county should be adopted, the city of Youngstown would have to pay 48 per cent. of the tax.

New York.—The Brooklyn *Eagle* says: "If the question of establishing a uniform system of good roads throughout Queens County and providing for their maintenance by a county tax could be put to a vote of the farmers we are inclined to think it would be settled in the affirmative all but unanimously. When the roads are hard and the ruts are solid the question does not seem so pressing, but when a wet spell comes and the farmers are compelled to hitch on double teams to haul their wagons through the mud they begin to realize their folly in neglecting this important reform. The present roads cost the farmers more, in the added expense of sending goods to market, in the injury to horses and the wear and tear of wagons, in a single year than three years' burden of

the tax that would be needed to put the roads in good condition."—The Troy Citizens' Association and Bath Citizens' Association propose to build a boulevard between Bath and Troy.

Missouri.—At Kansas City the committee of citizens who are interested in the proposed macadamizing of the principal county roads has decided to recommend the voting of bonds to the amount of $1,500,000 with which to make the proposed improvements, and after a few preliminaries are arranged the committee will take charge of the work necessary to have a bond election. A petition signed by one-tenth of the tax paying voters in each township in the county asking for the election must be presented to the county court. Aside from members of the committee a large number of citizens, mostly farmers, were present and while their views differed as to the manner in which the improvements were to be secured, all agreed that good macadamized county roads were needed and should be constructed with all possible haste. The chairman appointed a committee consisting of Messrs. Mastin, Lippincott, Slaughter and Lipscomb to confer with the Independence committee and the Kansas City authorities for the purpose of harmonizing the park district and road questions.

WATER-WORKS.

NEW ENGLAND.

Eden, Me.—The following report has been submitted:

That the town agrees to pay Bar Harbor Water Co. the sum of $100 per hydrant, per year, for all hydrants furnished up to and including 50; and the sum of $50 per hydrant, per year, for all hydrants over 50; and that the town agrees to remit the taxes of said company in consideration of water furnished for drinking fountains, sewers, etc. This contract is to run for a period of 10 years, after which a new one must be made.

Rollinsford and Somersworth, N. H.—We have received the following information from W. F. Harman:

The construction of works depends upon whether the town of Somersworth will contract with a company or not. John C. Lothrop is President of the Somersworth & Rollinsford Water Co. James A. Edgerly or Dr. O. Q. Shapleigh, of Great Falls, N. H., can furnish further information. Water would probably be pumped to a reservoir. Estimated cost, $200,000.

Newton, Mass.—J. O. Whitney, Clerk of the Board, informs us that the following improvements will be made:

Laying about four miles of pipe, 20, 12, 8 and 6 ins. in diameter; setting 25 new hydrants; placing 240 meters and 20 valves; constructing a new reservoir, and extending the filter basin.

Pittsfield, Mass.—About 3,000 ft. of 4 in. pipe will be laid, two new hydrants, 10 valves, and 5 meters, set, this season. J. M. Hatch is Superintendent.

Abington, Mass.—Two new hydrants will be set, and about 200 ft. of 8-in. pipe will be laid, this year. Address A. H. Wright, Superintendent.

East Hartford, Conn.—Henry L. Goodwin, Edward E. King, William H. Olmsted, J. O. Goodwin, J. C. Taft, P. Garvan and S. A. Gardner, have been appointed committeemen to thoroughly investigate the question of water supply for the Fire District, with instructions to report on or before May 1.

MIDDLE.

Norwich, N. Y.—Bids will be received until March 31, by W. S. Franklin, Engineer, for constructing an additional reservoir. Proposal sheet and specification will be furnished by Mr. Franklin upon application.

Albany, N. Y.—The organization of a syndicate is projected by John Snaith and others for introducing a water supply. The proposed plan is to have the city's supply drawn direct from Rensselaer Lake, 3 miles distant, the lake's natural supply to be increased from Hungerkill Creek.

Cazenovia, N. Y.—A contract has been let for building works. Water will be pumped from springs to a reservoir.

Jordan, N. Y.—The taxpayers have cast 123 votes against, 13 for, accepting the plant established by the New York Mfg. Co.

Coxsackie, N. Y.—The question of constructing works is being agitated, and efforts are being made to have some system established. The plans proposed are to pump water from the river, or use some of the large springs a few miles back of the town.

Babylon, N. Y.—The Lockwood Water Co. has withdrawn its proposition to supply the district from this plant located at Bay Shore, and there is a probability that a home company will soon be organized.

Newark, N. J.—McKee & Wilson, of Bethlehem, Pa., have received the contract from the East Jersey Water Co. for 25 miles of steel-plate water pipe, 48 and 36 ins. in diameter, for the pipe line to Newark from the new reservoir in the Pequannock Valley. The contract calls for a head of 400 ft. McKee & Wilson are erecting a hydraulic plant at Paterson, for the manufacture of the pipe.

Plainfield, N. J.—The following statement made in our issue of Feb. 22 is incorrect:

The two engineers recently engaged by the city to ascertain the extent of Plainfield's natural water supply have reported that it is doubtful if water can ever be obtained in sufficient quantities by boring. The contractor has been unable to secure water in sufficient quantities by this plan.

It is now believed that pure water in sufficient quantities can be secured by boring.

Beaver Falls, Pa.—The Beaver Valley Water Power Co. will soon commence building a reservoir on the hill near the Dead Man's Hollow, on the east side of the Beaver River, for the purpose of supplying the towns of this valley with pure water from above the sewerage line. The Penn Water Power Co. will furnish the supply from a reservoir to be formed, constructing a dam, near the Fetterman bridge. The approximate outlay for the system will be $250,000.

Allegheny City, Pa.—The survey for a new water supply has been nearly completed by Robert Swan, and a report will probably be made at the next meeting of the City Council. Surveys were made to Six Mile Island, Nine Mile Island and Logan's Eddy, the latter a point 16 miles above the city. Superintendent Edwin Armstrong, and the other members of the water department, are of the opinion that Nine Mile Island is the best source from which to take the supply. A natural pool is located at this point, and by constructing a dam 2,000,000 or 3,000,000 galls. of water can be secured. The current of the river at this point is on the Pittsburg side of the river, and the heavy sediment and debris would pass down with the current, and would in no way affect the purity of the water. The cost of the new water supply will be about $2,000,000.

Washington, D. C.—The work of laying the large mains is progressing rapidly. Col. Elliot's last report states that 1,622 ft. of 48 in. had been laid during the month, and that work on the 30 in. main has been completed; 21,905 ft. of 48 in., and 5,542 ft. of 30 in. pipe, are now down. During March it is proposed to continue work on the 48 in. main on Bridge St., on the canal road, for the connection at the reservoir, to make the connection of the mains at New Jersey Ave. and B St.; insert a valve on the old 30 in. main on New Jersey Ave.; insert a 12 in. blow-off in the same main near D St.; commence work on the by-passes across the old main on New Jersey Ave. to connect the low levels of Northeast Washington with the low service of the rest of the city; complete the connection at R and 17th Sts. between the 48 in. main and the old 20 in. pipe of the distributing system; place two 48 in. valves in the new main in Georgetown, and build a masonry gate chamber over them; lay a 36 in. valve in a cross connection with the old 36 in. main at the same point; to complete the masonry of the abutment of the new Rock Creek Bridge; complete the replacing of the portion of the dam at the reservoir that was excavated for making the connection, and provide extra pipe, lifting jacks, efficient pumps, and other articles required, for any breaks that may happen in any of the mains.

SOUTHERN.

Clifton Forge, Va.—We have received the following from E. Grover:

The new works will be completed about April 1. The contractors are the Glamorgan Co., of Lynchburg, Va. Water will be pumped from Smith's Creek to a 300,000-gall reservoir. Designing Engineer, W. S. Hungerford. Constructing Engineer, Edmund Grover, of Iron Gate, Va.

Greenville, S. C.—The City Council has adopted a resolution authorizing the electric-light committee to advertise for bids for constructing works. Address E. F. S. Rowley, Mayor.

Aiken, S. C.—The following is from a letter sent to the *Journal & Review*, by P. A. Emanuel:

I know of plenty of pure springs near enough to Aiken to supply us with all the water we need. It depends upon the report of a civil engineer as to the ultimate selection.

Dawson, Ga.—A $50,000 system of works is to be established by R. L. Bennet, of Philadelphia, Pa.

Atlanta, Ga.—The City Council has indefinitely postponed the date upon which a citizen's vote will be taken on the question of issuing water and sewer bonds.

Savannah, Ga.—A new 16,000,000 gall. pump, standpipe, larger mains, etc., are the improvements proposed for this year.

Athens, Ga.—A private system of works is to be erected.

Bridgeport, Ala.—Contracts for building water and electric light works will be let in about 10 days.

Canton, Miss.—The Artesian Well Committee has arranged with another company to take charge of the unfinished artesian well, and expects soon to secure water in sufficient quantities to supply the town.

Trenton, Tenn.—Proposals are wanted by T. J. Hoppell for constructing a $20,000 system of works.

Johnson City, Tenn.—The Wautauga Water Co. has been chartered.

Union City, Tenn.—S. Waddell, Mayor, has sent us the following:

The contract for constructing works has been awarded to Henry Hungerford, of New York. By the terms of the contract the contractor is to furnish water suitable for all purposes, 8 miles of mains, 80 hydrants, to be completed by Jan. 1, 1891. Estimated cost, $80,000. Water will be pumped from wells to a stand-pipe. Population, 4,500.

Stanford, Ky.—A vote will be taken on April 5 to decide the question of issuing $20,000 of bonds for constructing works.

Covington, Ky.—A press report states two of the large mains burst, and that the pumping engine was partially wrecked, on March 15. The same report states that the engineer in charge of the station has been dismissed, from which it would seem that the accident was owing to his negligence.

NORTH CENTRAL.

Cuyahoga Falls, O.—A bill has passed the Senate authorizing the town to issue $15,000 of bonds for securing a water supply.

Cleveland, O.—George S. Paine, E. J. Blandin and C. H. Pritchard, Trustees of Water Works, will receive sealed proposals until March 26, for furnishing, delivered in Cleveland, such number of 4-in. and 6-in. double-discharge fire hydrants, to set 6 ft. deep, with frost case, and valve to open against pressure, as may be required during the year 1890. Bidders are requested to exhibit models and drawings.

Also for furnishing and delivering nine 36-in. and 13 16-in. geared screw water valves, and one 36-in. check valve, the 36-in. screw valves to be geared to work horizontally. All to be tested under a hydrostatic pressure of 300 lbs. per sq. in. Bidders are requested to exhibit models and drawings of their valves. John Whitelaw is Superintendent and Engineer.

Tiffin, O.—The contract for furnishing the valves and hydrants for the extensions to be made this year has been awarded to the Eddy Valve Co., of Waterford, N. Y.

Canton, O.—A petition has been presented to the council by the citizens for its approval of an outlay of $351,000 in bonds for improvement.

East Liverpool, O.—The bill authorizing the city to issue bonds for constructing works has passed the Senate.

Mansfield, O.—The City Council has adopted a resolution to forward a petition to the Legislature, asking authority to issue $50,000 of bonds for extensions.

Benton Harbor, Mich.—Hinds & Bond, of Watertown, N. Y., have been awarded the contract for constructing work. By the terms of the contract they are to furnish 70 hydrants for an annual rental of $2,660, for 15 years.

Muskegon, Mich.—Chester B. Davis, of Chicago, has been engaged to make plans for a new system of works. Water will either be taken from Lake Michigan or the river.

Coldwater, Mich.—Plans and specifications for a system of works have been prepared by Morgan & Co., of Chicago. The estimated cost is $70,000, exclusive of the necessary sewerage. The question of acceptance will be submitted at the spring election.

Detroit, Mich.—The Water Board has awarded the following contracts:

George S. Langley, for constructing a brick conduit and wells for the new inlet pipe at $16,469; furnishing the new inlet pipe, Stephen Pratt, $17,998. The Russel Wheel & Foundry Co., for furnishing sluice gates at $3,825

Special castings, Detroit Pipe & Foundry Co, at $2.40 per 100 lbs. Valves, the Murdock Valve Co.; 4-in., $5.50; 6-in. $8.75; 8-in., $14.50; 10-in., $19.

Frankfort, Mich.—We have received the following information from C. Burmeister:

The village Council has appointed a Water Commission to make arrangements for, and superintend the construction of, a system of water-works. Bonds have been voted, and everything is in readiness to open negotiations with practical builders for making plans and specifications, and receiving bids. N. A. Parker is chairman of the committee.

Chicago, Ill.—The Chicago Pure Water Co. has been incorporated, to purify water and steam for domestic and other uses. Capital stock, $500,000. The incorporators are: A. C. Thatcher, R. H. Towne and G. N. Harris.

Lake View, Ill. (Now a part of Chicago.)—Previous to the annexation, this town voted to issue $50,000 of bonds for extending the tunnel. The Mayor states that the banks will not accept Lake View city bonds, there being no such city as Lake View, and suggests that the only practicable way of carrying out the scheme is to have the bonds reissued by the City Council of Chicago.

NORTHWESTERN.

Hawarden, Ia.—W. W. Hall, President of the First National Bank, has sent us the following:

On Feb. 26 the bid of G. P. Wheeler, of Beloit, Wis., was accepted for constructing works. The contract price is $6,910.

Litchfield, Minn.—Sealed proposals for constructing a system of works, according to plans and specifications now on file, until March 31, by Richard Welch, Village Recorder. For further information see our advertising columns.

Winona, Minn.—City Engineer John B. Fellows informs us that that the following improvements will be made:

Laying 900 ft. of 24-in., 740 ft. of 16-in., 370 ft. of 8-in. pipe; setting 10 hydrants, and 4 valves.

Albert Lea, Minn.—William A. Morin has sent us the following:

The city has just given E. T. Sykes & Co., of Minneapolis, Minn., a franchise to erect works. Works will be commenced about May 1.

Hutchinson, Minn.—Recorder E. J. Stevens informs us that the 4 in. well, 204 ft. deep, is flowing 130 galls. per minute; also that pipes will be laid from year to year as funds can be secured. Work will be commenced about May 1.

Owatonna, Minn.—Sealed proposals will be received by the Mayor and City Council until April 8, for supplying the labor and material for the construction of works in accordance with the plans and specifications. For further particulars see our advertising columns. W. W.

Curtis, of St. Paul, is the Engineer. Mayor, E. M. Morehouse.

Humboldt, Neb.—We have received the following information from Attorney J. E. Shravger:

Work will probably be commenced about May 1. Water will be pumped from wells to a reservoir. Estimated cost, $17,000, to be procured by city bonds. The date for letting contracts has not been decided upon. Population, 1,500. The works are to be completed by Sept. 1.

Beatrice, Neb.—An ordinance has been passed by the City Council to extend the water mains, and calling for an election to vote $10,000 of bonds therefor.

Wymore, Neb.—City water bonds to the amount of $30,000 have been sold to Spitzer, of Toledo, O.

Tilford, So. Dak.—A complete system of works will be put in this spring.

Woonsocket, So. Dak.—Connection has been made with the artesian well, which forces a solid stream of water 150 ft. high through 1,000 ft. of hose.

Faulkton, So. Dak.—Water has been struck in the artesian well at a depth of 1,210 ft., and a pressure of 100 lbs. to the sq. in. secured. The supply is sufficient to give the town good fire protection as well as an abundance of water for other purposes.

SOUTHWESTERN.

Lamar, Mo.—At a meeting of the City Council on March 8, the following propositions for establishing works were opened: C. B. Ingels, of Nevada, Mo., 5 miles of mains, 60 hydrants, $3,000 per year, and $45 per year for each additional hydrant. A. H. Snyder and J. Gurney, of Lamar, Mo., 5 miles of mains, 50 hydrants at $55 each per year, or 60 hydrants at $50 each; $45 for each additional hydrant. John R. Truesdale, of St. Louis, Mo., 6 miles of mains, 70 hydrants, $3,000 per year; $42.88 per year for each additional hydrant. John E. Cockrell, of Nevada, Mo., 5 miles of mains, 60 hydrants, $3,000 per year: $40 for each additional hydrant. The Montauk Construction Co., of New York, 5 miles of mains, 50 hydrants, $3,000 per year; $40 for each additional hydrant. All bids were for twenty years' contract. The franchise was awarded to A. H. Snyder and J. Gurney.

Springfield, Mo.—Richard Kerens, L. M. Rumsey and others, contemplate the construction of a new system of water-works.

Hannibal, Mo.—The Hannibal Water Co. has purchased 18 acres of land on the highest point in the vicinity of the city for the purpose of building a reservoir of 25,000,000-galls. capacity. The reservoir now in use has a capacity of 1,500,000 galls., but it is not high enough to furnish sufficient pressure for fire purposes and running machinery by water motor, and the pumps are run almost constantly to keep up the supply. The new reservoir will have a capacity to furnish four months' supply at the present consumption. Work will be commenced this season, but will not be completed until next year.

Luling, Tex.—The City Council desires proposals for constructing a system of works until April 14. Address F. C. Chase, City Secretary.

Nacogdoches, Tex.—We have received the following:

Works will be built by the city, and Thomas & Gorman of Houston, Tex., jointly. No stock has yet been taken. The matter is in embryo. Estimated cost, $35,000. The supply will be taken from Spring Lake. Fire hydrants will be used, and water will be furnished for domestic use. Population, 2,000.

Brackettville, Tex.—It is reported that the Haines, Brackett, Fort Clarke & Rio Grande R. R. Co. will establish works.

Denver, Col.—The Eddy Valve Co., of Waterford, N. Y., has been awarded the contract for furnishing the valves that will be required by the American Water Works Co., of Omaha, Neb., in connection with their work in improving the plant of the Denver Water Co.

Akron, Col—A $30,000 system of works will be established. The supply will be taken from a well.

Lookout and Golden, Col.—(Suburbs of Denver.)—F. G. Patterson, Secretary of the Lookout Water Supply Co., has sent us the following information:

Contracts will be let during the coming summer Surveys are now being made. Water will be pumped from Beaver and Soda Creeks to a reservoir. Golden has contracted to pay $5,500 per year. The estimated cost of the works is $100,000.

Las Vegas, N. M.—The Jacarilla Water & Mining Co. has been incorporated by A. A. Jones, M. A. Otero, D. C. Winters. Capital stock, $1,000,000.

PACIFIC.

Wallula, Wash.—Secretary L. G. Davis has sent us the following:

The Wallula Water & Motive Power Co. has done nothing as yet except to survey the line for the ditch. Work will not be commenced this season.

North Yakima, Wash.—George W. Rodman has sent us the following:

Definite arrangements for new works have been made, and the plant is all purchased except the pumps. Work is about to be commenced. Edward Whitson is President of the company.

Seattle, Wash.—At a recent informal meeting of the City Council, the Cedar River water proposition, in its larger features, was practically abandoned, and Engineer Williams was instructed to prepare a report for a system looking to Lake Washington for its immediate supply, but adapted to future development.

North Seattle, Wash.—The Union Water Works are now running. The company is putting in a heater and a feed pump to further equip the plant, and it contemplates the addition of an air-pump and a condenser, which would increase the capacity to about 700,000 galls. daily. At present the works pump 400 galls. per minute, and run eight hours per day.

Waitsburgh, Ore.—City Clerk R. H. Omsbee, sends us the following:

The town is now waiting for authority from the State Legislature, to enable them to bond the city to raise funds.

The Dalles, Ore.—The bids received on Mar. 4 for the water bonds were all rejected. Sealed proposals will be received until April 15, by the Board of Water Commissioners of Dalles City, for 200 bonds of $500 each; $25,000 payable in five years; $25,000 payable in ten years; $25,000 payable in fifteen years; $25,000 payable in twenty years. M. T. Nolan is Secretary.

East Portland, Ore.—The Water Committee recently appointed to investigate the question of water supply have submitted their report. They recommend the construction of a new system of works, the supply to be taken from Asylum Springs, or the Columbia River. It was also moved and carried that the chair appoint one man from each ward in the city to proceed with the organization of a joint stock water company. Louis Nicolai, Cyrus Buckman, Dr. C. H. Raffety, H. C. Meyer and others were appointed. The capital stock will be about $120,000.

The following estimate of cost has been made by the plant committee: Mains, $31,000; pumps and air chamber, $13,000; pumping station, $10,000. Estimated total cost, $59,400.——The East Portland Water Co. has offered ot sell its entire plant to the city for $112,500.

Los Angeles, Cal.—The Committee on Fire and Water has recommended the granting to Major E. L. Stern of a franchise to lay water pipes in the streets, and the City Council has unanimously passed an ordinance to make the grant. The new company is to furnish water free to the city for public uses and work is to begin on the enterprise at once.

San Bernardino, Cal.—Sealed proposals will be received by the Board of Trustees until April 8, for furnishing the following supplies and doing the following work:

627.35 tons of cast iron pipe, 114,155 ft. of Kalamein converse lock joint pipe, 98,755 ft. of lap-welded wrought-iron screw pipe, 15,400 ft. of riveted steel pipe; also, for trenching, laying and covering the 15,400 ft. of steel pipe; 70 double-nozzle fire hydrants, 90 gates, 163 special castings.

The above supplies and work must be furnished in accordance with specifications to be had on application to F. C. Finkle, Engineer and Superintendent of the water-works. Bids for each kind of pipe are to be separate, and to be delivered to the Clerk of said Board. Address B. B. Harris, Clerk of the Board.

Santa Cruz, Cal.—The city officers have discovered that about two miles more of 14-in. pipe will be required than was provided for in the original estimate. The difference in the cost of the works will be about $14,000. The taxpayers have paid about $30,000 to purchase water rights of settlers along Laguna Creek for the new water supply.

Oceanside, Cal.—The trustees have contracted with the San Luis Rey Water Co. to supply the town with water from the San Luis Rey River within 30 months. The company receives a 50 years' franchise, and agrees to lease the present system for that length of time, with the privilege of extending the mains. They are to put in a reservoir and more pipes within 5 months, so as to supply the city with 200,000 galls. of water daily.

CANADA.

Barrie, Ont.—The Standing Committee on Water-Works has been authorized to receive offers for the franchise and construction of a system of water-works. Immediate application to be made to J. L. G. McCarthy Chairman of Committee on Water-works.

New Westminster, B. C.—The Water Commissioners have decided to adopt the reservoir system. J. T. Fanning, of Minneapolis, Minn., has been engaged as Consulting Engineer to report upon the plans and specifications now under consideration, and upon his approval of them, bids will be asked for at once for constructing the works. Arthur E. Hill has been appointed Engineer in charge of the works.

PROJECTS.

Shelby, Ala.——Baxter Springs, Kan.——Humboldt, Neb.——Hinsdale, Ill.——Pana, Ill.; J. O. Hawker.——Griffin, Ga.; Mayor.——North Danville, Va——Gainesville, Ga.; E. E Dixon, H. H. Perry or A. W. Van Hoose. ——Bronwood, Ga.——Sault Ste. Marie, Ont.; T. A. Elliott. ——Attala, Ala.——Little Rock, Ark.— Willmette, Ill. ——Redding, Cal.——Tarboro, N. C.

ARTESIAN WELLS.

Alton, Ill.—Prof. Wm. McAdams is making a diagram for a well to be sunk on the premises of Mrs. L. V. S. Ames, at Notch Cliff. It is estimated that the well will be 1,000 ft. in depth.

Harrold, Tex.—The town will contract with a party for sinking a well. Address W. T. Knox.

Beresford, Dak.—Work has been commenced on a well.

IRRIGATION.

Denver, Col.—The Colorado Eastern Irrigation, Land and Reservoir Co. has been incorporated by J. W. Graham, H. T. Shrock and Charles E. Sexton for the purpose of constructing irrigating ditches in Otero, Bent and Prowers counties. Capital stock, $100,000.

Santa Fe, N. M.—The Model Ditch Co. has been incorporated by Wilson Dalton, D. Sullivan and D. F. Daniels, of San Juan County. Capital stock, $5,000. The company's object is to construct a ditch, taking water out of San Juan River, near Largo.

Julesburg, Col.—The proposition of a syndicate of Boston capitalists, offering to spend $800,000 in constructing irrigating ditch, as provided they are allowed three-tenths of the water, has been accepted, and the company are under bonds of $75,000 to begin work before July 10.

SEWERAGE AND MUNICIPAL.

Street Work.—It is reported that 13 miles of asphalt paving will be laid this year at Buffalo, N. Y.

At Philadelphia, Pa., the Highways Committee will expend $375,000 on street repaving.

Street improvements are to be carried out at Elkins, W. Va., at a cost of $20,000 or $30,000.

The Barbourville Land & Improvement Co., of Barbourville, Ky., will macadamize 5 miles of streets. D. J. Conger, of New Albany, Ind., has a contract for grading.

The Fort Payne Block Asphalt Paving Co., of Fort Payne, Ala., has a contract for paving Whiteside St., Chattanooga, Tenn.

It is proposed to pave Government St., at Mobile, Ala. The cost would be $40,000.

Street improvements are projected at Westerville, O. Mr. Holman, of Columbus, O., has estimated the cost of brick paving at $1.40 per yd.

At Marion, Ind., it is proposed to lay brick paving. For particulars address Mr. A. E. Steele.

The Board of Public Works, Detroit, Mich., is considering the merits of different materials for paving.

The Street Committee of Alton, Ill., has recommended that the city pay 20 per cent. of the cost of repaving the streets.

The Town Board of Kirkwood, Mo., held a meeting recently for the purpose of considering the advisability of making extensive street improvements The Committee on Streets and Alleys made an elaborate report of improvements contemplated by the board, among which was the macadamizing and graveling of all the principa streets within the town limits and the openiug of several new streets. The estimated cost of the contemplated improvements is $14,280. The proposed work will necessitate the floating of a bonded debt of $15,000.

Sewerage.—The Sewer Commissioners of Thompsonville, Conn., will receive bids for the building of several thousand feet of sewers this season.

At White Plains, N. Y., a committee has been appointed to engage an engineer to determine whether the outlet pipes to the disposal works can be lowered so as to pass under the Bronx River by gravity instead of by siphon.

At Poughkeepsie, N. Y., the work under the present contract for the construction of the upper Main St. sewer has been ordered discontinued by the Board of Water Commissioners, and new bids have been advertised for.

The contract for the Second St. sewer extension, at Jersey City, N. J., has been awarded to P. J. Condon & Co., at $21,887.

Capt. J. H. Rucker is chairman of a committee appointed at Athens, Ga., to consider the sewerage question.

City Engineer Ellis, of Jacksonville, Ala., is carrying out sewer extensions.

A sewerage system is to be built at Lancaster, O., this season, at a cost of $30,000.

The contract for sewers at Sioux City, Ia., has been awarded to W. P. Whitten and E. J. Hanlon, at $35,282.90.

Mr. Lewis Kingman, City Engineer of Topeka, Kan., will let contracts this month for a large amount of sewer work. Pipe sewer: 16,230 ft. of 9-in., 6,495 ft. of 12-in., 3,545 ft. of 15-in., 350 ft. of 18-in., 375 ft. of 21-in., 735 ft. of 24-in. Brick sewer: 1,350 ft. of 30-in., 110 ft. of 30-in. (3 ring), 445 ft. of 36-in., 445 ft. of 39-in., 1,725 ft. of 42-in., 1,160 ft. of 45-in., 175 ft. of 48-in., 1,250 ft. of 60-in., 200 ft. of 60-in. (3 ring). Also 44 catch basins, 65 manholes, 30 inlets, overflow, earth and rock excavation, concrete, timber, etc.

At East Portland, Ore., the sewerage question has been investigated by a commission, which has recommended that Mr. Rudolph Hering be engaged to report upon the matter.

It is proposed to spend $50,000 or $60,000 for sewerage at Ellensburg, Wash.

Mr. J. A. McIntyre, City Engineer, of Denver, Colo., has presented plans for storm sewers.

ELECTRICAL.

Electric Lighting.—At Rockville, Conn., it is proposed to form a stock company, and put in an electric light plant to furnish 40 arc lights and 400 incandescent lights. The Westinghouse Co. offers to put in the plant for $13,000, and the local company will ask $40 for the arc lights and $10 for the incandescent lights each per annum. W. F. McDonnell, George Y. Young and J. C. Whittlesey are appointed a committee to dispose of the stock.

The Troy Gas Co. has been awarded a 5-years contract for lighting the streets of Troy, N. Y., with 280 arc lights at 39½ cts. per night. The aggregate of the contract is

$40,369 a year or $201,845 for 5 years. The price under the contract with the Troy Electric Light Co. was 43¾ cts. per light per night.

At Manlius, N. Y., a contract has been let for 16 Schuyler arc lights at $60 each per annum.

The Board of Contract and Apportionment, Albany, N. Y., has been authorized to advertise for bids for lighting by the Brush system, 50 additional electric lights, from May 15, 1890, to June 21, 1891.

At New Castle, Pa., the following bids have been received for street lighting: Thomson-Houston Co., $100 per light; United Edison Mfg. Co., $90; Fort Wayne Electric Co., $90 and $92.

At Lake Charles, La., a franchise for electric lighting has been granted to A. Munger, of New York.

The Board of Public Works, Milwaukee, Wis., proposes to put in an electric light plant at a cost of $20,000.

A vote will be taken at Fremont, Neb., on a proposition to issue $15,000 in bonds for street lighting.

The City Council of Fort Worth, Tex., has voted to issue $125,000 in bonds for establishing an electric light plant.

BRIDGES, TUNNELS AND CANALS.

Bridges.—***Montreal & Ottawa Ry.***—Work is now in progress on the 300-ft. bridge at Rigaude, Ont. The company will also build bridges at Plantagenet and Ottawa, Ont., 600 ft. long each. J. M. Shanley, 44 Imperial Building, Montreal, P. Q., is Chief Engineer.

Montreal, P. Q.—The plans for the proposed bridge across the St. Lawrence River, between this city and Longueuil, P. Q., have been completed. According to the plans the total length of the structure will be 8,440 ft. The channel portions will consist of two cantilever spans 450 ft. each, supported on masonry piers 120 ft. apart, and connected by a 200 ft. truss span. In addition to the two cantilevers there will be 22 spans of 200 ft. each, 10 spans of 120 ft. each and 1 span 260 ft.

New Haven, Conn.—A correction should be made in the bid of Milliken Bros., for the steel arch bridge at New Haven, Conn., as given in our last issue, it being $3,338, intead of $4,338 as then reported.

Norwich, O.—A bill has passed the Ohio State Legislature authorizing the construction of a bridge in Norwich Township, Franklin County, O., to cost $40,000.

Detroit, Mich.—The River Detroit Ry. Bridge Co. has a bill before the Canadian Parliament, asking authority to build a high level bridge across the river at this point. It is proposed to have a main span of 1,065 ft. with two 750 ft.; the structure to be 140 ft. above high water mark. The total length will be 2,600 ft., and the cost is estimated at about $5,000,000.

Glasgow, Va.—Bridges are proposed across the North and James rivers at this place. The Rockbridge Co. can give information.

Oxford, Ala.—A bridge will be built over Rumis Creek at this place. J. T. De Armau can give information.

Chattanooga, Tenn.—The Chattanooga Land, Coal, Iron & Ry. Co. will build a steel bridge.

Green Bay, Wis.—The contract for repairing the Main street bridge has been awarded to Messrs. Hansen for $5,194.

Oconomowoc, Wis.—This city will vote on an appropriation of $6,000 for a bridge at the coming municipal election.

Fort Smith, Ark.—Anderson & Barr, together with the Union Bridge Co., have taken the contract for constructing a railway and highway bridge across the Arkansas River at this point. It will consist of ten 200 ft fixed spans and one 370 ft. draw span. Foundations are all on pneumatic caisson with the exceptions of the abutments.

Missouri Pacific Ry.—The contract for constructing 9 combination bridges for this company has been awarded to Shaler & Shniglau, of Chicago, Ill.

Grayson Co., Tex.—J. P. Austin, Clerk of Grayson Co., Tex., will receive bids for the construction of one iron and five combination bridges until April 15.

Hempstead, Tex.—The County Commissioners will erect two iron bridges across the Brazos River.

Robertson Co., Tex.—Bids are asked for the construction of two wooden bridges, 240 ft. and 100 ft. long respectively. G. R. Dunn, County Judge.

Salem, Ore.—The County Court has ordered the rebuilding of the bridge across the Willamette at Salem, and also a new bridge across the Santiam at Jefferson. It was ordered that $10,000 be appropriated for the purpose of rebuilding the bridge across the Willamette at Salem, on condition that Polk County pay the same amount, and the city of Salem the remainder necessary to rebuild said bridge, provided that the whole cost shall not exceed $40,000; but should it exceed that sum the two counties and the city shall pay an equal proportion of such cost. It was ordered that $6,000 be appropriated toward building a bridge across the Santiam at Jefferson, provided Linn County pay the balance.

Colorado.—The Bullen Bridge Co., of Trinidad, has been awarded the contract for constructing a two-span bridge, the first span being 180, and the second 196 ft., over the Gunnison River, eight miles above Delta, Colo., the amount being $17,289.

Pueblo, Colo.—The city council has passed the ordinance providing for the erection of a steel or iron viaduct on C St. over the tracks of the Denver & Rio Grande R. R. The viaduct will be 1,220 ft. long, with a roadway 30 ft. wide, and two sidewalks 6 ft. wide each. It will cost about $60,000, two-thirds of which amount will be paid by the city.

Washington, D. C.—The following bridge bills have passed the House of Representatives: For a railway and wagon bridge across the Mississippi River at South St, Paul. The bill was amended so as to provide that the work shall be commenced within one year and completed in three; bills for bridges across the Minnesota River from Hennepin County to Dakota and Scott counties, were passed. These are to be wagon bridges. One bridge is to be at Bloomington Ferry or Lyndale Av., and the other is to be located by the commissioners of Hennepin and Dakota counties, either in section 13, township 27, range 24, or in section 18, township 27, range 23; a bill for a bridge across the Red River of the North, at or near Grand Forks, for the Crookston, Fort Stevenson & Montana R. R., was also passed. This is said to be in the interest of the Northern Pacific; a bill for a bridge across the Missouri, at Pierre, S. D.; a similar bill introduced by Senator Pettigrew has passed the Senate. Senator Pettigrew to-day introduced a bill authorizing the Chamberlain Pontoon Bridge Co. to bridge the Missouri River at Chamberlain.

Proposed.—Bridges are proposed at Dayton, Tenn. and Winona, Minn.

Tunnels.—***Denver & Rio Grande R. R.***—A press dispatch from Leadville, Colo., quotes Mr. S. J. Riley, one of the contractors at the Streeter tunnel, Tennassee Pass, as saying that good progress was being made with the work. Already 706 ft. have been driven, and two air shafts have been completed. Work is being driven in both directions from the bottoms of the shafts, as well as from both approaches. It is expected that the work will be completed in three months.

CONTRACTING.

Gate House.—The following proposals for the gate house superstructure on section No. 1 of the new Croton Aqueduct, have been received by the Aqueduct Commissioners, New York City.

		John Pierce.	Smith, Brown & Coleman.
Granite dimension stone masonry	240 cu. yds.	$50.00	$50.00
Dimension stone masonry	75 " "	50.00	21.60
Broken ashlar " "	100 " "	35.00	16.00
Fine hammered (6-cut) face dressing	10,000 sq. ft.	0.75	0.50
Rough pointed face dressing	1,500 "	0.50	0.25
Face brick masonry	900 sq. yds.	3.50	5.00
Brick masonry for filling	125 cu. yds.	12.00	12.00
Main roof		9,019.50	5,700.00
West roof		2,400.00	2,240.00
East roof		2,520.00	1,615.00
North roof		1,811.25	770.00
Combination iron double doors	No. 3	603.75	600.00
" " " " "	" 1	577.50	575.00
" " single " "	" 1	388.50	300.00
" " " " "	" 4	341.25	275.00
Windows	" 8	155.40	175.00
"	" 4	140.70	150.00
"	" 15	71.90	100.00
Tile drain, 4-in	200 lin. ft.	1.00	2.00
" " 6-in	240 "	1.00	2.00
" " 8-in	100 "	1.00	2.00
Macadam pavement	3,000 sq. yds.	2.00	3.00
Stone block pavement	300 "	4.00	3.00
Total bid		$61,78. 50	52,320.00

Stone.—The following bids have been received by the New York Docks Department: For 1,000 cu. yds. of cobble stone, J. A. Bouker, 80 cts. per cu. yd.; Brown & Fleming, 98 cts. For 1,000 cu. yds. of rip rap stone, J. A. Bouker, 57 cts.; Brown & Fleming, 58 cts.

Sewers.—The following proposals were received March 14 by Mr. A. J. Cooper, City Engineer, Easton, Pa. (The work was advertised in our advertising columns, with satisfactory results, as we are informed by Mr. Cooper.)

Bidders.	Brick Sewer.							Vitrified Pipe Sewer.						1,150 ft. of 18-in. Cast Iron pipe.	27 Lamp-holes.	108 Man-holes.	10 Flush Tanks.	10 Catch Basins	120 Inlets.	Totals.
	1,060 ft. of 63x49 ins.	3,975 ft. of 52x36 ins.	4,300 ft. of 45x30 ins.	1,150 ft. of 5 ft. diam.	1,075 ft. of 4 ft. diam.	1,100 ft. of 3 ft. diam.	550 ft. of 24-in.	1,600 ft. of 20-in.	600 ft. of 18-in.	3,300 ft. of 15-in.	18,240 ft. of 12-in.	600 ft. of 9-in.							
John T. Fitzpatrick	7.50	11.89	8.39	9.53	6.50	9.77	1.70	1.43	1.35	1.22	1.87	.29	2.94	13.00	37.00	45.00	65.00	35.00	174,607.55
P. Frank Harman	6.21	5 91	7.00	8.46	5.86	7.16	2.13	1.70	1.76	1.38	1.02	.57	3.10	1.02	56.76	37.50	63.70	27.80	152,724.33
Fogg & Scribner	8.56	8.12	7.50	8.87	8.12	7.37	2.25	2.10	1.75	1.25	1.15	.50	3.25	20.00	50.00	100.00	90.00	100.00	144,193.50
Peter Forve & Bro	9.52	8.79	10.20	9.20	8.59	9.00	1.93	1.40	1.23	1.15	1.10	.40	2.68	2.50	70.00	45.00	95.00	89.00	161,598.50
Shanley & Mack	12.00	12.00	10.00	15.00	10.00	9.75	3.50	3.00	3.00	2.90	2.90	1.00	3.25	3.00	30.00	100.00	30.00	100.00	233,854.50
R. A. & B.E. Malone	7.00	8.00	8.60	13.00	8.00	9.00	2.50	2.30	2.00	2.25	3.15	.25	4.10	5.00	35.00	87.50	50.00	40.00	196,105.00
T. M. Lesher & Son	7.65	7.38	8.14	10.48	7.22	7.71	1.41	1.60	1.47	1.19	1.10	.25	2.47	3.00	49.50	62.49	94.00	39.50	142,704.90
John Jacoby	5.55	5.40	8.20	10.00	8.00	6.00	1.80	1.35	1.20	2.40	1.65	.50	3.00	1.50	40.00	35.00	90.00	30.00	128,538.00
James Smith	5.85	5.60	5.10	7.32	9.02	6.30	1.50	1.37	1.27	1.23	.85	....	4.00	24.00	34.50	57.00	76.00	50.00	114,885.00
Dani. F. Minahan	6.13	5.68	5.20	7.40	9.25	7.56	1.55	1.30	1.25	1.18	.84		3.90	23.00	36.00	54.60	72.00	47.00	116,792.25
B. J. Coyle	7.45	6.80	9.80	11.90	6.48	8.00	1.90	2.50	1.45	1.90	2.40	1.90	6.90	4.00	40.00	65.00	90.00	15.00	178,857.50
James J. Cogan	6.58	6.75	9.70	15.33	9.00	9.90	2.54	1.00	.92	2.09	1.50	.50	4.16	4.00	28.00	90.00	90.00	50.00	169,017.75
Thomas Craig	7.80	8.41	6.49	9.01	7.85	6.60	2.76	2.37	2.06	1.89	1.66	1.45	7.60	12.00	50.00	160.00	65.00	60.00	161,273.90
James H. Edwards	5 41	5 47	8.16	9.11	7.00	5.36	1.80	1.40	1.27	1.07	1.30	.30	2.75	3.00	35.00	85.00	45.00	30.00	129,577.75
Saml. B. Mutchler	5.10	5.54	5.83	7.66	4.86	4.90	1.50	1.25	1.25	1.00	.90	....	3.0	2.00	35.00	50.00	90.00	40.00	108,504.00
P. P. Bradly	5.65	6.25	11.25	12.50	6.75	8.78	2.00	1.15	1.10	2.74	1.60	.30	3.25	2.00	40.00	95.00	60.00	35.00	166,167.25
Everson & Liddle	5.70	5.50	6.00	9.00	4.50	6.00	1.75	1.50	1.25	.90	1.25	.35	2.50	3.00	40.00	47.00	90.00	50.00	119,803.50
Achuff & Little	8.50	8.00	10.50	11.00	10.00	8.00	4.00	2.95	2.00	3.45	3.35	....	5.50	10.00	50.00	150.00	100.00	175.00	223,979.00

Asphalt Paving.—The following proposals for asphalt paving on concrete foundations on portions of certain uptown streets have been received by the Commissioner of Public Works, New York City. It is stated that these bids were lower than any formerly made, when in some cases the city paid as much as $5.10 per sq. yd., with a 15 years guarantee, the lowest bid being $3.33, with a 5 years' guarrantee. The new bids were figured out at $3.14.

Location.	Sicilian Asphalt Co.	Warren-Scharf Asphalt Paving Co.	Barber Asphalt Paving Co.
No. 1. 73d St., West End Ave. to Riverside Drive	$4,163.30	$4,241.50	$4,334 25
No. 2. 117th St., St. Nicholas to 8th Ave.	6,959.12½	6,746.82	7,064.03
No. 3. 119th St., St. Nicholas to 7th Ave.	5,124.17	5,007.62	5,160.98
No. 4. 128th St., St. Nicholas to 8th Ave.	3,528.00	3,426.00	3,439.00
No. 5. 134th St., St. Nicholas to 8th Ave	4,137.00	3,982.00	4,046.25
No. 6. 120th St., 7th to 8th Ave.	9,995.06	8,408.66	8,867.39
No. 7. 133d St., St. Nicholas to 8th Ave.	3,558.18	3,459.78	3,478.87
No. 8. 106th St., 8th Ave. to the Boulevard	59,571.60	47,195.68	51,704.64

Paving Blocks.—The following proposals for granite paving blocks have been received by W. L. Dickinson, Superintendent of Streets, Springfield, Mass.: Quincy Granite Co., West Quincy, Mass., $1.56 per sq. yd.; Timothy Keefe, Chester, Mass., $1.57; W. N. Flint & Co., Monson, Mass., $1.60: Geo. D Webb, Worcester, Mass., $1.65; Chas. A. Banley, Suncook, N. H., $1.65; Geo. E. Lyons, Greenfield, Mass., $1.70. The contract was awarded to Geo. D. Webb; his blocks have been found to wear smooth, but not slippery.

Brick.—The Sewer Commissioners of Pawtucket, R. I., have awarded the contract for 500,000 brick for the East St. sewer to Sylvester Dresser, of Southbridge, Mass., at $9 per 1,000 on the cars.

Public Buildings.—At Philadelphia, Pa., the contract for wards Nos. 4 and 5 of the new county prison has been awarded to J. E. & A. L. Pennock, at $152,955. The contract for grading was let to Charles McCaul, at 27 cts. per cu. yd.

Competitive plans for a jail for Ohio county will be received until April 7 by Charles C. Woods, County Clerk, Wheeling, W. Va. It will be a 3-story brick building with stone trimmings.

Plans have been adopted and proposals invited for a $10,000 jail at Jonesboro, Ark.

Mayor Blake, of Bangor, Me., proposes to build a municipal building at a cost of $50,000.

The County Commissioners, Uniontown, Pa., have let the contract for the stone court house to Langhead, Modisette & Co., of Uniontown, at $228,500. This firm is completing the new jail.

Contracts for a brick court house at Vienna, Ga., will be let May 8.

Proposals for the erection of a brick and stone court house in Caddo parish, will be received until March 31 by J. M. Foster, Shreveport, La.

Buckets.—The following bids have been received by the New York Docks Department for three buckets for depositing concrete: Alexander Pollock, $190; H. A. Rogers, $210.

Wharf.—The contract for a concrete wharf at Wilmington, Del., has been awarded to Alvan R. Morrison at $7.20 per cu. yd.

Brick and Terra-Cotta.—The following proposals for brick and terra-cotta floor arches, etc., for the U. S. building at Pittsburg, Pa., have been received by James Windrim, Supervising Architect, Treasury Department, Washington, D. C.: Pioneer Fire Proof Construction Co $27,500; additional terra-cotta 9 ins. deep, 21 cts. per sq. ft. 12 ins. deep, 25 cts. per sq. ft. L. L. Porter, Chicago,

$25,631; additional brick arches, 19 cts. per sq. ft.; additional terra-cotta arches 9 ins. deep, 27 cts. per sq. ft.; 12 ins. deep, 28½ cts. per sq. ft. Wight Fire Proofing Co., Chicago, $21,976.16; additional brick arches, 18½ cts. per sq. ft ; additional terra-cotta arches 9 ins. deep, 18½ cts. per sq. ft.; 12 ins. deep, 23 cts. per sq. ft. Bart Donaven, Allegheny, Pa., $33,874; additional brick arches, 33 cts. per sq. ft.; additional terra-cotta arches 9 ins. deep, 35 cts. per sq. ft.; 12 ins. deep, 37 cts. per sq. ft. Empire Fire Proofing Co., Pittsburg, $22,650; additional brick arches, 16 cts. per sq. ft.; additional terra-cotta arches, 9 ins. deep, 20 cts. per sq. ft.; 12 ins. deep, 24 cts. per sq. ft.

Cross Ties.—The Cincinnati Street Ry. Co., of Cincinnati, O., has let a contract to Goodman, Wright & Foster for pine ties at $22 per 1,000.

Dredging.—The following was the only bid received March 13, by Lieut.-Col. G. L. Gillespie, U. S. Engineer Office, New York City, for dredging in the main ship channel, New York Harbor: Joseph Edwards Dredging Co., 23½ cts. per cu. yd.

Light Station.—The following proposals for the construction, completion and delivery of the Coney Island light station have been received by Major Heap, U. S. Lighthouse Engineer, Tompkinsville, N. Y.: Francis H. Smith, New York, $2,680 for foundation, $1,225 for erection; $13,750 for dwelling, grading, fog-bell tower, port beacon. Linus Seeley, Woodfords, Me., $2,000, $2,500, $10,210. D. J. Roberts and D. L. Conover, Atlantic Highlands, N. J., $890, no bid, $7,750. Jas. W. Lanning, Trenton, N. J., $3,035, $950, $10,300. John Cox, Brooklyn, N. Y., $2,389.40, $2,626.80, $12,687.45. Peter Knowe, Newport, R. I., $1,257 $512, $7,455. Howe & Dash, New York, $2,275, $1,200 $10,245.

PROPOSALS OPEN.

Valves and Hydrants.—Furnishing nine 36-in. and thirteen 16-in. geared screw water valves and one 36-in. check valve. The 36-in. screw valves to be geared to work horizontally, and all to be tested under a hydrostatic pressure of 300 lbs. per sq. in. Furnishing 4-in. and 6-in. double discharge fire hydrants, with frost case, and valve to open against pressure. John Whitelaw, Superintendent of Water Works, Cleveland, O. March 26.

Pier.—New wooden pier, with temporary approach, appurtenances and sewer box at W. 45th St., North river. The Docks Commissioners, Pier A, North River, New York City. March 26.

Sewers.—Main sewer on Superior St. W. P. Rice, City Engineer, Cleveland, O. March 27.

Surveying.—Surveying and staking and furnishing three maps. W. G. Nelles, Clerk, Burlington, Ont., Canada. March 27.

Dredging.—For bulkhead wall at. W. 33d St. section, North River, 22,000 cu. yds.; for new pier at W. 45th St., North River, 37,000 cu. yds.; total, 59,000 cu. yds. Also the following: East River, Canal St., 1,250 cu. yds.; W. 19th St., 1,500 cu. yds.; North River, Pier 12, 2,500 cu. yds.; Pier 44, 1,000 cu. yds.; Piers 51 and 52, 1,650 cu. yds.; E. 17th St., 1,500 cu. yds.; E. 22d St., 7,500 cu. yds; total, 16,900 cu. yds. The Docks Commissioners, Pier A, North River, New York City. March 28.

Water-Works and Electric Light Plant.—Richard Welch, Village Recorder, Litchfield, Minn. March 31.

Bridges and Culverts.—Iron bridges, 50, 25 and 20 ft. span; 20 ft. span wooden bridge; 2 culverts. F. J. O'Flaherty, County Surveyor, Kansas City, Mo., April 1.

Pipe Sewers.—Furnishing pipe for about 8,000 ft. of sewer; also laying. L. A. Union, Chairman of Sewer Commissioners, Thompsonville, Conn. April 1.

Rip Rap and Paving.—Watchman's house, fence, sidewalk, slope paving, curbing, gutters, rip rap protection and painting at the Eastern Branch bridge. Lieut. Col. Peter C. Hains, U. S. Engineer office, Washington, D. C. April 4.

Paving.—Laying about 8,500 sq. yds. of Telford pavement. Joseph R. Gawthrop, Chairman of Street Committee, Kennett Square, Pa. April 15.

Granite and Steel.—Rolled steel beams; 2,200 cu. ft of granite, for the Mare Island Navy Yard. James Fulton, Paymaster General, U. S. N., Navy Department, Washington, D. C. April 15.

Paving and Curbing.—Fire-brick paving, 25,000 sq. yds., sand-stone curbing, 4,000 lin. ft. L. G. Brock, City Clerk Moundsville, W. Va April 16.

Jail.—Architects, W. W. Goodrich, Atlanta, Ga. T. J. Hightower, Chairman of County Commissioners, Decatur, Ga. May 5.

Bridge.—Plans, specifications and bids; bridge 90 ft. long; approaches 130 yds. J. S. Tooker, clerk, Helena Mont. June 1.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Richmond Locomotive & Machine Works, of Richmond, Va., have recently built some consolidation engines for the Richmond & Danville. Cylinders, 20x24 ins.; driving wheels, 50 ins. diameter; driving wheel base, 14 ft. weight on driving wheels, 106,000; total weight, 120,000 lbs.

The New York Locomotive Works, of Rome, N. Y., have an order for 32 engines for the Union Pacific; 10 six-wheel switch engines, cylinders 18x26 ins.; 5 ten-wheel engines, cylinders 19x24 ins.; 17 ten-wheel engines, cylinders 20x24 ins.

The Baldwin Locomotive Works, of Philadelphia, Pa., have an order for 7 ten-wheel engines, with cylinders 20x24 ins., for the New York, Pennsylvania & Ohio. They will be similar to the engines now in use on the New York, Lake Erie & Western. The works are also building 8 switch engines for the Merchants' Bridge, St. Louis, and a small engine for the Maule Coal Co., of Belleville, Ill. A "Mason bogie" engine, with steam truck, has been built for the Mexican Central.

The Dickson Mfg. Co., of Scranton, Pa., is building 40 engines for the New York, Ontario & Western.

The Cooke Locomotive Works, of Paterson, N. J., have an order for 35 passenger and freight engines for the Illinois Central.

The Schenectady Locomotive Works, of Schenectady, N. Y., have turned out a heavy passenger engine for the New York Central; also, 10 consolidation freight engines, with cylinders 21 x 24 ins., for the Chesapeake & Ohio.

The Manchester Locomotive Works, of Manchester, N. H., have turned out a heavy passenger engine for the White Mountain division of the Boston, Concord & Montreal. The engine has 6 driving wheels, 66 ins. diameter; boiler, 53 to 59 ins., 10 ft. 9 ins. from rail to top of boiler, 14 ft. 8 ins. from rail to top of stack; weight, 60 tons.

The Brooks Locomotive Works, of Dunkirk, N. Y., have built 2 passenger engines for the Milwaukee Northern, and 10 engines for the New York, Chicago & St. Louis.

The Pittsburg Locomotive Works, of Pittsburg, Pa., have built 5 engines for the St. Louis, Vandalia & Terre Haute.

The Baltimore & Ohio R. R. will add 30 locomotives to its equipment.

The Chesapeake & Ohio R. R. is having 19 locomotives built.

The Pennsylvania R. R. has put 2 large freight engines, built at the Altoona shops, on the Indianapolis & Columbus Division.

The Louisville, New Albany & Chicago R. R. have put 2 freight moguls into passenger service. They weigh nearly 70 tons each.

Cars.—The Wason Mfg. Co., of Springfield, Mass., is building 6 passengers for the Pike's Peak R. R., and some passenger cars for the Brooklyn, Bath & West End; 12 passenger cars have been built for the Maine Central.

The Laconia Car Co., of Laconia, N. H., is building 10 passenger cars for the Boston & Maine.

The Jackson & Sharp Co., of Wilmington, Del., has delivered 2 drawing-room cars, seating 24 persons each, to the Cincinnati, Wabash & Michigan.

J. G. Brill & Co., of Philadelphia, Pa., have delivered 2 passenger cars and 1 combination baggage and passenger car to the St. Augustine & North Beach. Also 6 passenger cars to a Mexican narrow-gauge road.

The Pullman Car Co., of Chicago, Ill., has recently sold to the Louisville, New Albany & Chicago 9 cars, costing $78,987.84, and a dining and parlor car, costing $15,174.43. The company is building for the Philadelphia & Reading 25 passenger cars and 4,000 gondola cars of 25 tons capacity. Also 10 passenger and 20 suburban cars for the Illinois Central.

The Litchfield Car Works, of Litchfield, Ill., are building 1,000 box cars for the Chesapeake & Ohio.

The Missouri Car Co., of St. Louis, Mo., has an order for 1,000 box cars, all fitted with air brakes, for the Chesapeake & Ohio. Also 1,000 box cars for the Cleveland, Cincinnati, Chicago & St. Louis.

The Indianapolis Car Works, of Indianapolis, Ind., have completed 500 coal cars for the Pittsburg & Western They are now building cars for the Choctaw road, Indian Territory. Everything except the body is of iron. Each car is equipped with the Westinghouse air brake and the Janney coupler, and has a carrying capacity of 60,000 lbs. Fifty of these cars have been shipped. The works are to be enlarged.

The East Tennessee, Virginia & Georgia R. R. is receiving bids on 15,000 freight cars; all equipped with M. C. B couplers.

The Houston & Texas Central R. R. will purchase 300 box cars at about $165,000.

The Baltimore & Ohio R. R. will add 25 passenger cars and 6,000 freight cars to its equipment.

The American Equipment & Storage Warehouse Co., which is owned by the American Car & Equipment Co., of New York, is building a storage warehouse at Lake View, N. J., on the line of the Erie R. R. The intention is to store cars and locomotives and do repairs required there.

Car Heating.—At the recent meeting of the Standard Car Heating & Ventilating Co., of Pittsburg, Pa., the purchase of the patents covering railway car heating appliances was taken up. The Standard Car Heating & Ventilating Co. negotiated with the Consolidated Car Heating Co., of Albany, and finally purchased all of the patents owned or controlled by that firm. The purchase was unanimously ratified by the stockholders present. By the acquirement of these patents the Standard Co. is placed in control of most of the important systems of car heating. The object is to place the heating service on the same basis as the air brake device, thus making it more serviceable by bringing it under one general control. The following officers were re-elected to serve the ensuing year: President, Geo. Westinghouse, Jr.; Secretary Asaph T. Rowand.

Cofrode & Saylor.—The firm of Cofrode & Saylor, builders of iron bridges and contractors for the construction of piers, warehouses, etc., whose office is at 257 South Fourth St., Philadelphia and extensive works at Pottstown, has been chartered as a stock company, under the name of Cofrode & Saylor. The new company was organized by the election of Francis H. Saylor, President; Joseph H. Cofrode, Vice-President; J. E. Challenger, Secretary and Treasurer; George M. Evans, Auditor, and F. H. Saylor, J. H. Cofrode and P. R. Foley, Directors. The capital stock is $500,000. The entire business of the firm has been transferred to the company, but the Reading Rolling Mill Co., whose works are at Reading, though the stock is owned by the same parties, is a separate corporation. Cofrode & Saylor, incorporated, employ about 600 workmen at Pottstown, and at the present time 400 men are engaged in outside operations. The late firm, since establishing works at Pottstown, 12 years ago, has been very successful. The plant has been enlarged almost every year, and the trade of the concern extends to all parts of the country.

Car Coupler.—The George G. Lane Car Coupling Co., of Prosperity, S. C., has been incorporated by Geo. L. Lane, R. L. Luther, and others, of Prosperity, and J. K. P. Goggans, of Newberry. Capital stock, $10,000.

The Aluminum Mfg. & Car Co., of Chicago, has been incorporated by S. W. Adams, A. R. Wilson and Nicholas Heinson, to manufacture aluminum and construct railway cars. Capital stock, $1,000,000.

Brake Beams.—The Michigan Railway Supply Co., of Detroit, has an order for 8,000 steel brake beams for 2,000 box cars being built by the Missouri Car Co., of St. Louis.

Electric Headlights.—C. H. Corey, Superintendent of Motive Power of the Cincinnati, Hamilton & Dayton lines, has made arrangements with the National Electric Headlight Co. to equip several locomotives with the light.

The Chicago Railway Supply Co., of Chicago, Ill., has been incorporated by M. H. Grabble, H. M. Walker and T. A. Quinlan. Capital stock, $300,000.

Pumping Engines.—The Barr Pumping Engine Co., of Philadelphia, has under construction a pump of 3,000,000 galls. capacity for the new shops of the Pennsylvania R. R. at Altoona, for fire purposes. The company has also an order from the National Tube Works for 5 pumps of 2,500,000 galls. capacity for the new Monongahela furnaces at McKeesport, Pa.

The South Brooklyn Steam Engine Works Co., of Brooklyn, N. Y., has been incorporated by D. M. Cobb, Catharine C. Cobb, and L. T. Cobb. Capital stock $50,000.

Filters.—The Hyatt Pure Water Co. reports 19 contracts for filters for factories, ice plants, hotels, etc.; also 37 filters for private residences.

Railway Material.—Rails for 10 miles of track. E. C. Colgan, West Virginia, Pineville & Tennessee R. R. Co., Pineville, Ky.

Street rails. R. L. Bennett, President, Tallahassee St. Ry. Co., Tallahassee, Fla.

Material for logging railway 8 miles long. D. J. McMillan, South Washington, Pender Co., N. C.

Drilling Machinery.—Plant wanted by Roy Allen, New Hagerstown, O.

Metal Market Prices.—***Rails.***—New York, $34 to $34.50; old rails, $24.50 to $25 for iron, $21.50 for steel. Chicago: $36 to $37.50; old rails, $23 to $24 for iron, $21.50 to $22.50 for steel. Pittsburg: $33.50 to $34.50; old rails, $25 to $26 for iron, $22.50 to $23 for steel.

Track Materials.—New York: steel and iron angle bars, 2.10 to 2.15 cts.; spikes, 2.15 to 2.25 cts.; track bolts, 3.10 with square and 3.20 to 3.25 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2 cts.; spikes, 2.15 or 2.25 cts. delivered at Chicago or St. Louis; track bolts, 2.90 to 3 cts. with square and 3.10 to 3.20 cts. with hexagon nuts. Chicago: splice bars, 2 cts. for steel and 1.85 cts. for iron; spikes, 2.25 cts.; track bolts, 2.80 to 2.85 cts. with square, and 2.95 to 3 cts. with hexagon nuts.

Pipe.—Cast iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded, 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent. discount.

Lead.—New York, 3.97½ to 4 cts.; Chicago, 3.80 to 3.85 cts.; St. Louis, 3.77½ cts.

Structural Material.—Chicago: iron or steel angles, 2.45 to 2.55 cts.; universal plates, 2.50 cts. for iron; 2.55 cts. for steel up to 16 ins. wide, 2.70 for wider steel; steel sheared plates, 2.80 cts.; beams and channels, 3.30 cts. Pittsburg: angles, 2.30 cts.; tees, 2.75 cts.; channels, 3.10 cts.; sheared bridge plates, 2.80 cts.; universal mill plates, 2.45 cts.; steel plates, 4.25 to 4.75 cts. for firebox; 3.25 cts. for flange, 3.05 for shell, 2.75 for tank.

Nails.—Pittsburg: steel cut nails, $2.25, 60 days, 2 per cent. off, for carload lots, and $2.35 for less than carload; wire nails, $2.75, 60 days, 2 per cent off for cash, for car lots,